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Landmark

New horticulture and viticulture research facilities at East Malling

In this Issue

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Food security is back to the fore

Recent events in Ukraine have shaken us and brought to the forefront of our minds the horror of war. This conflict will also have a direct impact on energy prices across Europe which is compounded by an already high inflation rate.

Ukraine is an important grain producer, and with its growth in the past decade it was on course to becoming the world's third largest wheat and maize exporter. The impact that the war could have on Ukraine's crop production, combined with the effect on the fertiliser supply chain of sky-high fuel prices and shortage of natural gas, provide all the ingredients to trigger a food crisis at a global scale.

In truth this should not be a new issue: the fragility of the global food system and how its disruption could impact countries that largely depend on imports to feed their population has been discussed widely in recent years. About half of the food consumed in the UK is, for instance, imported!

In one of her recent articles in *Landmark*, my predecessor Professor Tina Barsby raised the alarm: "Let us not fool ourselves – to feed a global population which is increasing by about 83 million people per year we need to produce food intensively and sustainably".

Although the UK is largely self-sufficient in the production of grains, we are still dependant on imports for protein feedstock and milling-quality wheat. Our reliance on specific inputs also makes us vulnerable as the overall supply of fertilisers and pesticides will all be affected.

On a positive note, Defra recently published the outcome of the consultation on urea fertilisers and guidance on organic manures in relation to the Farming Rules for Water. NIAB worked with other industry organisations to develop an alternative to the original proposed regulatory options, including a potential ban, on solid urea fertilisers.

The solution that was finally adopted by Defra is based on the industry's alternative which will have less impact on farming businesses whilst still achieving a reduction in ammonia emissions comparable to the original targets. NIAB also supported the development of the guidance for implementing the Farming Rules for Water, a great example that demonstrates the value of NIAB's expertise and position as trusted partners with industry.

Much could be said about our over-reliance on synthetic fertilisers and the role that other options such as low-input varieties or nitrogen-fixing protein crops could play in the future of the UK's rotation.

When it comes to legumes, for instance, there has not been a clear policy or market incentive for growers to adopt them. If we are to build a more resilient food system whilst meeting some of the milestones related to climate change, this is something that will need to be addressed sooner rather than later.

Pre-pandemic I regularly visited the University of Saskatchewan in Saskatoon, Canada, as a member of one of the scientific advisory boards associated with the Global Food Institute. On one of my trips, I learned that Canada is the largest exporter of dried legumes in the world.

Canada has been one of the most successful countries in developing a competitive pea and lentil industry. The province of Saskatchewan produces 95% of Canada's total lentil production. This is quite remarkable when you hear that they only began growing lentils in the province in the 1970s.

Short of a miracle, this is an interesting case study. A deeper analysis reveals a strategy that has brought together growers and the supply chain, supported by public sector funding schemes. Today, Canada invests annually the equivalent of £360 million in agricultural research and crop demonstration centres.

The annual investment in pulse crop variety development in western Canada, for instance, has averaged £5.1 million over the decade 2002 to 2011. This was mostly provided by the public sector to develop plant breeding with an incentive for industry-led research that helped kickstart the sector.

The example of Canada illustrates how the combination of industry-driven research and sustained R&D investment

could rapidly develop the pulses sector. This is particularly relevant as the UK population migrates to a diet richer in alternative protein sources, and growers explore the opportunities to incorporate nitrogen-fixing crops into their rotation.

Without the initial development of legume cultivars by public institutions and the focus on addressing the limitations of the supply chain, Canadian growers would not have seized the opportunity.

As we navigate the immediate challenges of the current uncertainties, we should keep in mind the role of innovation in food production. We might not be able to prevent the immediate food crisis but we should learn from this and move fast to avert the next one.

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Cereal candidates to look at in 2022

With crops in the ground now moving quickly it is time to look ahead at the new candidate varieties that will be on show this summer. All the main cereal crops are represented as there is no let up in the material coming forward from breeders.

Wheat

The 12 winter wheat candidates span all the quality groups, and we will have a look at the potential on offer. The three varieties with potential bread-making quality are all currently aimed at UK Flour Millers (UKFM) Group 2 and all have export potential.

KWS Ultimatum (KWS) offers a treated yield at a similar level to KWS Extase as well as a good untreated yield. It has excellent resistance to yellow rust, with a septoria resistance sitting at a reasonable 6, and limited data suggesting good eyespot resistance. It has shown good levels of protein and a high specific weight. **RGT Zinzan** (RAGT) is just 1% behind in treated yield and has tall, but stiff, straw. It has only moderate resistance to yellow rust but a solid 6 for septoria as well as Pch1 resistance to eyespot. It has good grain quality across the board and the added bonus of orange wheat blossom midge (OWBM) resistance, particularly useful in a quality variety. The final variety in this group is **KWS Wrenum** (KWS), again just 1% behind KWS Ultimatum in treated yield and with a good untreated yield. Its short, stiff straw is accompanied by moderate to good disease package as well as the useful OWBM resistance. As potential bread-makers these three varieties will be subject to a battery of further quality tests following harvest 2022 and the outcome of these will have a huge influence on their future.

The biscuit-making sector has seen a huge influx of new varieties over the past few years and this year we have two more to look at. **Gefion** (KWS) has a high treated yield, 5% above that of KWS Barrel, although its untreated yield is less attractive. This is likely to be a consequence of its poor yellow rust rating and moderate resistance to septoria, although it does offer OWBM resistance and a good specific weight. **RGT Wilkinson** (RAGT) offers a treated yield 2% better than that of KWS Barrel, has relatively good resistance to yellow rust as well as Pch1 eyespot resistance.

Four soft feeds have been promoted into AHDB Recommended List trials and will be hoping to enter the increasingly competitive soft feed market. The group is led by **LG Redwald** which offers an impressive treated yield, 3% above that of LG Skyscraper, as well as a good untreated yield. It is a tall variety which offers a good disease profile, with the exception of eyespot to which, limited data suggests, it is very susceptible. **KWS Webbum** (KWS) offers treated yields similar to LG Skyscraper and has moderate resistance to yellow rust and septoria and again, limited data suggests susceptibility to eyespot. The variety has a good specific weight. **Zoom** (Elsoms) has a similar treated yield and an excellent untreated yield. It is an earlier maturing variety with relatively good resistance to yellow rust and moderate septoria resistance. Limited data also suggests susceptibility to eyespot. **KWS Zealum** (KWS) is also in this group but it still awaiting addition to the National List.

Finally we have three hard feed candidates. With a trio of excellent new varieties added to the AHDB Recommended List in the autumn these varieties have their work cut out. **Mindful** (Agrovista) combines a competitive yield, both treated and untreated, with an excellent specific weight and a moderate disease resistance profile. On a similar treated yield is **Oxford** (DSV), which offers good yellow rust resistance combined with a 6 for septoria resistance. **SY Coach** (Syngenta) has a treated yield just 1% behind as well as a good untreated yield. It offers good to moderate resistance to both yellow rust and septoria.

With some very good varieties currently out on farm these newcomers will need to perform strongly this year to find a space commercially.

Spring wheat has seen

renewed interest and we have four candidates to consider, all with bread-making potential. **KWS Alicium** (KWS), **KWS Harsum** (KWS) and **KWS Lightum** (KWS) all have very competitive treated yields, with KWS Alicium also offering a good untreated yield. All three have sound disease resistance profiles and offer OWBM resistance as well as good specific weights. **Nimrod** (Saaten Union) has a slightly lower treated yield but has a good untreated yield and a good specific weight.

Barley

The winter barley candidates contain a new malting variety, **Buccaneer** (Saaten Union). Buccaneer has a treated yield 6% above that of Craft combined with excellent resistance to Rhynchosporium and a good specific weight. Whilst this yield potential is exciting, end user testing will continue after harvest and will be crucial to the progression of this variety.

The feed group contains a six row hybrid, **SY Nephin** (Syngenta), but this is still waiting to be added to the National List. The other three varieties are all two row. **LG Caravelle** (Limagrain) has demonstrated very high yield potential, up with the best six row hybrids. It has a good range of disease resistance and a high specific weight. **LG Campus** (Limagrain) is 3% lower yielding, but this still represents a very competitive yield. Limited data suggests some susceptibility to lodging. **Bolivia** (Agrii) offers a similar yield and has shown some brackling. It will be interesting to see if these varieties can maintain this high level of performance in the current season.

As is often the case these days there is a big group of spring barley candidates, one feed and 13 with malting potential. Out of the malting group the following await National Listing: **SY Tennyson** (Syngenta), **SY Signet** (Syngenta), **LG Mulgrave** (Limagrain), **Trent** (Agrovista), **SY Jewel** (Syngenta) and **LG Loxstar** (Limagrain).

Of the varieties with data available **Florence** (Senova), **KWS Curtis** (KWS) and **Diviner** (Agrii) all look to have very competitive yields without any major drawbacks. **RGT Starlight** (RAGT), **Maronis** (KWS), **Sun King** (Agrii) and **LG Flemenco** (Limgrain) look to have slightly lower yield potential with limited data suggesting that RGT Starlight and Maronis have weaker straw than the others. Malting testing still has some way to go for these varieties so we are unlikely to see much of them for at least another year.

Hurler (Agrii) is a feed variety with high yield potential, competitive with the current highest yielding varieties. If you are not chasing quality this is another variety to add to your considerations.

Oats

In the winter oats there are two candidate varieties, one of which, **RGT Silver** (RAGT) is still awaiting National Listing. **Cromwell** (Senova) offers a high treated yield combined with good kernel content and specific weight. It has short, stiff straw but is susceptible to mildew. The combination of yield and quality characteristics will be of interest to millers and growers alike, although the disease will have to be addressed.

There is only one spring oat candidate, **RGT Vaughan** (RAGT). The variety has shown moderate yields with good mildew resistance and some susceptibility to crown rust. Its quality data looks positive and it may well be of interest to millers going forward.

With the current commercial varieties choice offering some strong characteristics many of these varieties will struggle to compete, however one or two may shine through.

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Agri-robotics: developing a proving ground at NIAB

Agriculture has been one of the slowest sectors to adopt digital technologies but it is catching up, with both start-ups and established large companies looking at the use of data, and autonomous systems. Robotics is seen by many as an enabling technology for removing manual labour from farm operations, lowering crop inputs, and reducing environmental impact. The functions for which robots, drones and autonomous systems are in development include:

- scouting for weeds, pests, and crop health and development
- weeding
- seeding
- irrigation
- pruning and thinning
- picking and harvesting
- crop handling and logistics.

The opportunities in this sector are huge with the agri-robotics industry worth $4.9 billion in 2021 and growing at an annual rate of 19.3% making the industry worth $24 billion by 2030.

Different applications and different crops all present varying opportunities and challenges. In the first instance the most attractive targets for robotics developers are the high value fruit crops where plant management, harvesting and packing are all labour intensive and contribute 30-45% of the overall cost of production. Total labour costs for fruit in the UK are £300 million (Figure 1).

Another area where there has been significant interest is in scouting and weed management for arable and horticultural crops. The challenge in this sector is that labour costs are typically <10% of production costs and the areas covered are large. While the potential market is big, robotic solutions must be able to cover large areas rapidly and cheaply. Once the issues of both cost and range are addressed then there are savings in this area around crop inputs (fertiliser and crop protection products) through precision dosing and labour. Total potential savings in the UK are estimated at >£0.5 billion.

Technology development

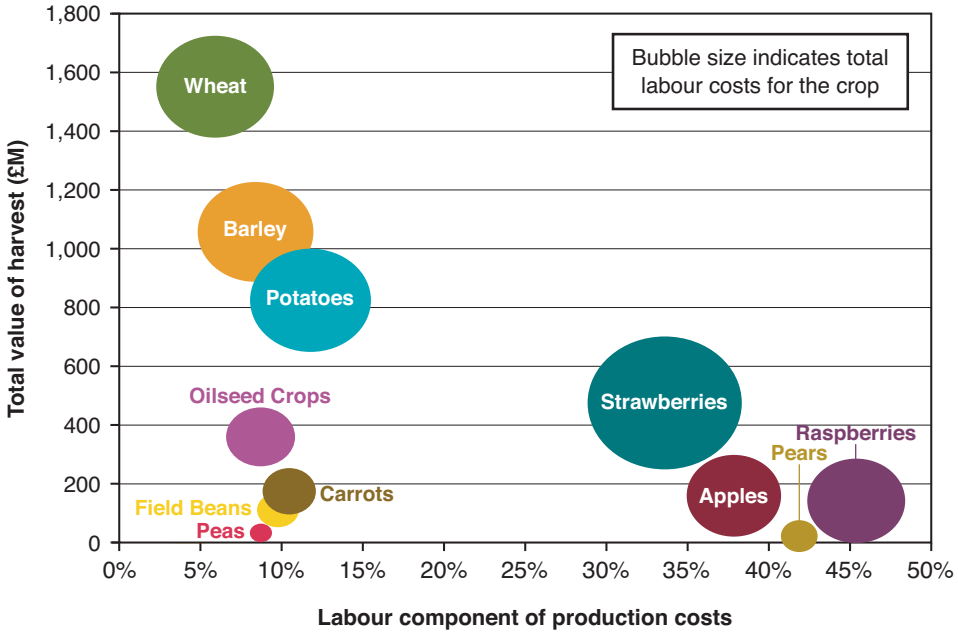
Most agri-robotic systems use a variety of discreet technology elements within their systems. These include but are not limited to:

- mechatronics
- control systems
- locomotion
- manipulators
- localisation and mapping
- vision and sensing
- decision making
- coordination.

Many of these technologies have been developed to a high degree of sophistication in other industries and only require adaptation for the agricultural sector. R&D activity to both develop new systems and adapt existing ones for agri-robotics is strong in the UK. What is observed, however, is that many agri-robotic developers are trying to solve all of the technical issues themselves rather than working from common platforms, components and approaches. This leads to high hardware and development costs, slower development and reduced competitiveness of the commercial offerings.

There is a relative weakness of the UK in getting products to a state of commercial readiness and launch into the market. The need to defragment the industry to stimulate commercial exploitation has been identified and reported. Despite the strong R&D component the UK is lagging behind other countries in Europe, the USA, Australia, and Japan in getting products into the market.

Figure 1. Labour component of production costs



Barriers to adoption

There are a number of barriers to adoption of robotics in farming, including:

- access to digital technologies
- poor rural connectivity
- lack of digital skills
- cost of robotic and autonomous systems
- small farm sizes leading to reduced economies of scale
- unpredictable weather
- lack of confidence due to lack of demonstrated capability
- restrictions on drone size and flying height.

Of particular interest to the case for an agri-robotic proving ground is the lack of confidence that farmers have in the technology. This can be assuaged by demonstrations on commercially relevant cropping systems.

It is worth noting the issues associated with both cost and the average size of UK farm holdings. Where a farm is arable in nature it would seem likely that the early adopters of robotic technology will be the larger farms. Fruit growers are typically located on smaller holdings and it is the value of their crops and the high labour content that makes them attractive for robotics development.

Smaller arable holdings will likely be addressed by

robotics at the point where the prices of equipment fall sufficiently to make economic sense or through the use of innovative business models such as buying the service rather than the hardware. The tenuous economics of these farms mean that adoption will only become widespread when the benefits are well established and clear.

NIAB robotics engagement

A growing number of companies are developing ever more capable robotic systems. NIAB is engaged with over 20 of these businesses and currently offers a range of services including:

- provision of test crops
- independent efficacy validation services
- ground-truthing data to verify accuracy
- image libraries and datasets to train algorithms
- advice on agronomy and farming operations
- trial ground management
- incubator space at Barn4, Cambridge.

In addition to these, NIAB hosts regular 'Meeting of Minds' workshops where robotics, and other agritech companies present their innovations to interested NIAB staff, to gain feedback and potential collaborations.

NIAB is also engaged in academic development of agri-robotic systems and is a partner in both the AgriFoRwArdS Centre for Doctoral Training in Agri-Food Robotics together with UEA, Cambridge and Lincoln universities and the Centre for Doctoral Training in Sensor Technologies for a Healthy and Sustainable Future at the University of Cambridge. These focus on basic research in the sector with NIAB supporting the transition into commercial environments.

Through the activities above, NIAB has observed an increase in demand for the provision of field testing and evaluation. This enables the transition of robotics from the lab to a realistic crop environment. It also provides a showcase for growers and other stakeholders to observe the robots in operation.

Proving ground

NIAB has recently completed an Innovate UK-funded feasibility study that looked at the case for a National Proving Ground for agri-robotics. Interviews were carried out with 21 agri-robotic companies and 15 growers. From these it was clear that there was a need for a platform where companies could develop, test and demonstrate their technologies. This had to provide access to crops grown using commercial techniques. In addition, companies needed space and facilities to develop their technologies during the period that they were using the proving ground.

A concept design has been developed that uses a Hub and Spoke model centred around one or two central Hubs with a wide range of growing systems and specialist facilities coupled with Spoke sites located across the country for convenient local access.

The physical testing facility would be supplemented with a suite of services available to robotics developers and virtual tools such as image libraries and crop models that could be used during the development process.

A site of this type would help bridge the gap that exists between early proofs of concept and final commercial systems being launched to the market. This opens an opportunity for the UK to become a leader in a globally critical industry and to take a significant position in a market expected to reach $24 billion by 2030.

Further reading

Information and papers used in the production of this article:

- Which industries are the most digital (and why)?, Gandhi *et al.*, Harvard Business Review, April 2016
- Agricultural Robots Market by Type (Milking Robots, UAVs/ Drones, Automated Harvesting Systems, Driverless Tractors), Farm Produce, Farming Environment (Indoor, Outdoor), Application, and Geography - Global Forecast to 2026, Markets and Markets report, June 2020
- 2020 data from the "Agricultural Budgeting and Costing Book", The Andersons Centre, May 2021 and Agriculture in the UK 2020, Defra
- Agricultural Robotics: The Future of Robotic Agriculture, Duckett *et al.*, UK-RAS, 2018
- The Economic Impact of Robotics and Autonomous Systems across UK Sectors, BEIS research paper 2021/043, November 2021
- AgriForwards – https://agriforwards-cdt.blogs.lincoln.ac.uk/about-us/
- CDT Sensors – https://cdt.sensors.cam.ac.uk/

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Training the next generation of crop scientists

About the author

Dr Richard Harrison is Director of NIAB's Cambridge Crop Research, which encompasses NIAB's work in arable genetics, biotechnology, pathology, data science and crop characterisation. He was the co-coordinator of the CTP consortium and bid with the industry lead and overall director of the CTP Emma Garfield (G's Growers).

In October 2022 the CTP (collaborative training partnership) programme for Sustainable Agricultural Innovation (CTP-SAI) begins, a new £3.6 million six-year programme to train the next generation of crop scientists. It aims to tackle some of the biggest challenges in broad-acre agriculture through a collaborative training partnership, working with some of the industries' leading agribusinesses, charities and research organisations. It is funded both by UKRI-BBSRC and by the industry partners within the consortium.

Transformation of the global food system to a system that is resilient to the in-train effects of climate change, that contributes a sustainable level of greenhouse gas emissions and that enables land use change for biodiversity restoration is one of the greatest challenges of our times. This is often referred to as a "wicked problem", a problem that is resistant to a solution due to the fact there is no single solution and that the complex interdependencies and social complexities within the system are often in opposition to one another.

Due to the complexity of this problem, many point to the need for "systems approaches" and "systems thinking". Like many high-level descriptions, what these systems approaches are is open to interpretation. Systems approaches range from highly quantitative approaches rooted in disciplines such as information theory, computing, engineering, artificial intelligence and logic, to descriptive sociological and philosophical approaches. The area of systems science is therefore one that is highly interdisciplinary. It is also an area which spans the public and private sector and is widely implemented in many forms in both the public and the private sector.

As scientists, the ability to identify and map the interrelations and complexities of real-world situations and the likely effects that a focused intervention might have upon that system is not generally part of a structured training programme, either at degree or post-graduate level. Indeed, for many scientific problems, a common method to try to understand how something operates is to systematically reduce complexity, holding normally variable components constant, to isolate and study the effect of a single intervention. Moreover, the pressure to relentlessly specialise is one that is often felt within biological and agricultural sciences, which leads to the criticism that scientists, especially at higher levels of qualification, are too blinkered to the 'bigger picture'. This is more easily

Figure 1. A diagram highlighting the dangers of complexity reduction

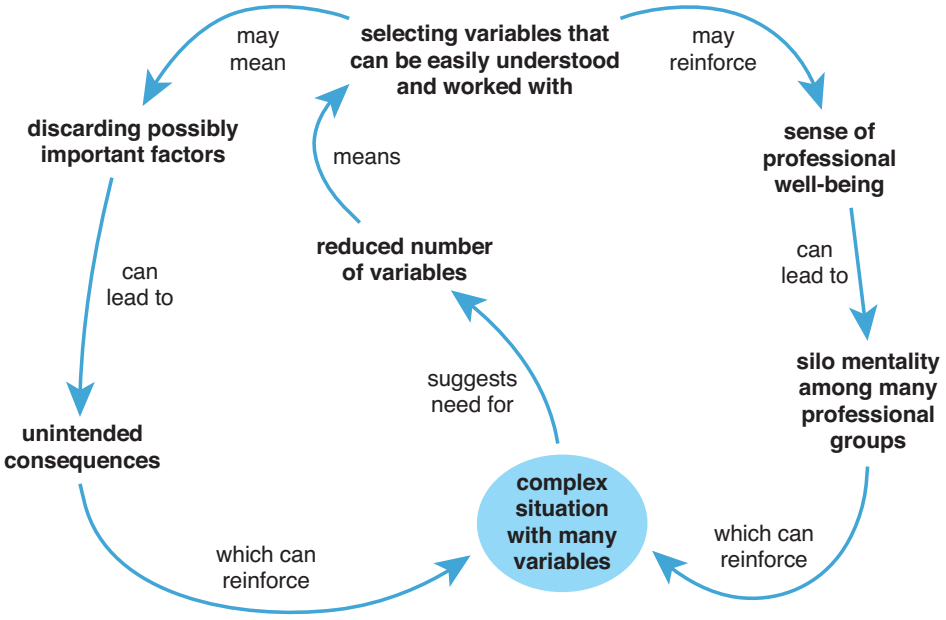


Figure 2. Consortium of CTP-SAI

illustrated in Figure 1, taken from an Open University introductory course to strategic thinking.

Recognition that the way that scientists are trained needs to change is growing along with the pressing need to ensure that in our training programmes the broader pluralistic approach of ensuring equality, diversity and inclusion in research is met.

This is why systems thinking and pluralistic approaches are at the heart of the new Collaborative Training Partnership, the aim of which is to train "new thinkers for new times", building a cohort of thirty or more PhD students to address the grand challenge of sustainable and equitable food production. This partnership is one that has been facilitated by NIAB due to its unique position in the research and innovation landscape and led by G's Growers on behalf of a diverse consortium of industry partners (Figure 2) including agricultural charities, agronomy organisations, breeding and agricultural product development companies and retailers. Ensuring that scientific discovery is formed into tangible, workable solutions requires a high degree of connectivity throughout the very non-linear research and innovation pipeline. The success or failure of solutions to reach the market is governed not only by the market demand for a solution, but the by people that work throughout the innovation pipeline and their ability to see and respond to opportunities that arise as a result of new innovation.

In the CTP proposal a pre-competitive consortium was formed to address the following shared challenges through science-led innovation:

- to ensure field-based agriculture is equipped with tools to enable resilient, sustainable and economic crop production whilst meeting consumer demands;
- to promote biodiversity through restoration or diversification of farmed habitats; and
- to substantially decrease greenhouse gas emissions from agriculture (and the supply chain).

Our consortium brings together a diverse set of academic partners and focuses cohort building activities around the focal points of the research

Figure 3. Crop priorities of the CTP-SAI Consortium (box sizes proportional to priority)

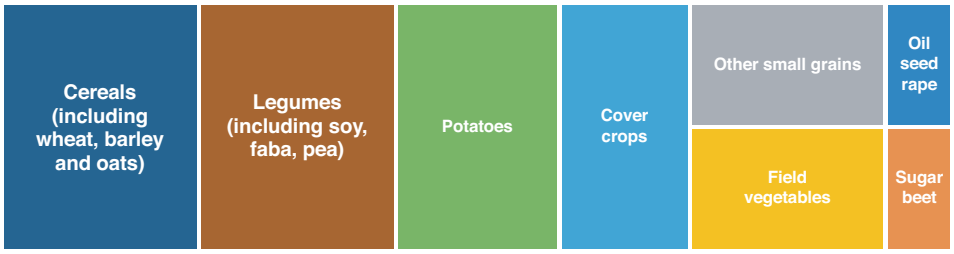
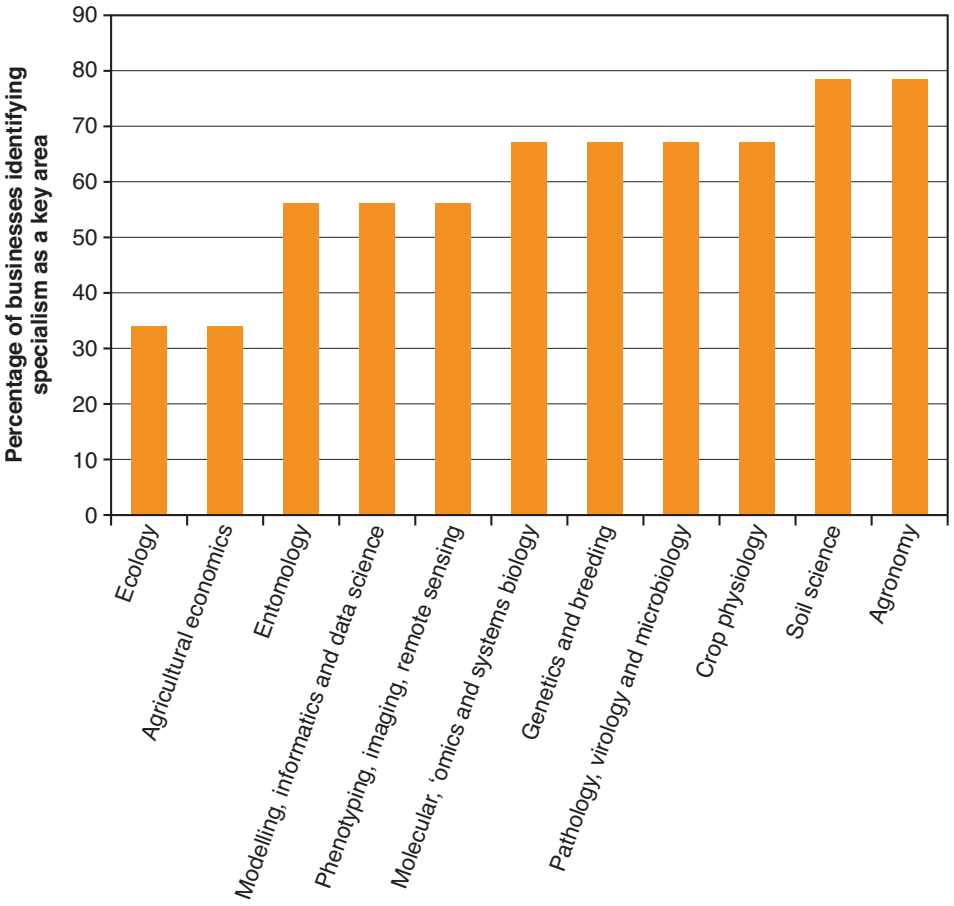


Figure 4. Key skill areas required in the crop science industry



institutes, NIAB and the University of Cambridge, working together under the Crop Science Centre alliance and the James Hutton Institute (Figure 2). In addition, seven universities are associate partners, focussing the wealth of research capabilities into the sector.

While the student training programme aims to give a global view of the food system and the skills required to think strategically about how science can lead to sustainable innovation, it is also crucial to train specialists to work on key crops and in key disciplines.

What is particularly striking about the list of identified crop priorities, in Figure 3, is the desire to drive forward research and development in legumes to a level on a par with wheat. The need for improved research capacity across a broader stable of arable and vegetable crops is clearly articulated by the industry consortium and within the first cohort of PhD students, due to begin in October 2022 there are studentships working on soya, field lettuce, diploid (true seed) potato and pumpkin as well as wheat.

Similarly, there is a diversity of skills training (Figure 4), with specialist training opportunities running from agricultural ecology and sustainability metric calculation, machine learning and modelling, genetics, biotechnology, pathology, soil science and agronomy to name a subset of the key areas.

This diversity within the cohort is deliberate, as there will be many opportunities for shared learning, trying

to break down the ever-present discipline-based siloes that still hamper progress of the sector.

The programme aims to place at least ten studentships per year across the network of academia and industry, ideally with one or more industry partners, an institute and a university contributing to the co-design of each PhD programme and supervisory team. By partnering with Wageningen University, UC Davis and the Australian National University it is also hoped that global exchange opportunities will be possible.

During the design process a very clear message from the industry consortium was the need for skilled postgraduates that had a wider understanding of how businesses operate. The consortium had partnered with MDS (Management Development Services), which runs one of the leading graduate placement programmes in the agri-food sector. MDS will coordinate high quality placements with industry partners, using their well-established methodologies in business training to ensure a high quality and rewarding experience in agribusinesses. This will be coupled with training delivered by industry and business experts at twice yearly cohort conferences which includes entrepreneurship activities delivery by the University of Cambridge's renowned Judge Business School.

This CTP is the first of its kind in the arable sector and it is hoped that it will provide impactful research outcomes, delivered through highly skilled, systems-thinking scientists, ready to work in the industry and provides the basis for a wider network of coordinated research and development activity in the arable sector.

Initiatives like this have never been more necessary as we collectively grapple with the need for national and global food security and sustainable food systems.

For more information contact Dr Fiona Leigh, Research Director of the CTP (ctp-sai-info@niab.com)

Visit the CTP-SAI website (www.ctp-sai.org) for more information

Subscribe to the CTP-SAI YouTube channel and view a video on the training partnership https://youtu.be/hIw3kLiSOHk

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New cutting-edge facilities set to advance horticulture and viticulture research at East Malling

If you have visited NIAB at East Malling over the past year, you would not have failed to notice some major reconstruction happening on the south side of the main driveway. In what might be described as the most significant new research facilities at East Malling in several generations, these are exciting times for everyone connected with the site, whose origins date back to 1913, when it was developed to undertake research to sustain and advance the burgeoning fruit growing industry in Kent.

The new development will be known as the GreenTech Hub for Advanced Horticulture. It is funded by the Growing Kent & Medway initiative, from the UKRI Strength in Places fund, the East Malling Trust, and Local Growth Funds from Kent County Council. The purpose of Growing Kent & Medway is to bring together innovative growers, processors, scientists, technologists, and entrepreneurs to stimulate research innovation and

The first point of call for visitors to the new GreenTech Hub – the Client Zone

business growth in the horticultural, food and drink industry in the Kent and Medway area. The new research facilities have been designed to cater for the cutting-edge research demanded by an industry that is continually evolving and adapting to meet the demands being imposed by an exacting food and drink market place. There is also pressure to develop more sustainable production systems to combat climate change.

In the past thirty years, the UK horticultural and fresh produce industry has seen a gradual shift away from the traditional open field production to protected cropping, where control of the environment is possible, and crops are in many cases grown in soilless substrate systems. Many growers and food producers have quickly had to learn new production skills and although protected cropping has overcome some age-old problems, it has brought with it both new challenges and new opportunities.

To the casual observer, the opportunity to grow higher quality produce and achieve higher cropping yields are obvious, but there are so many more hidden opportunities. The design of polythene-clad tunnels and glasshouses and the precision growing technologies available have made unparalleled advances in the horticulture and food industry to the point that computer controlled and robotic systems are commonly installed by growers. This provides a different level of control over light levels and wavelengths, temperature, humidity, spray application, crop protection, irrigation and nutrition. Any research and development facilities must be able to emulate the level of technology being employed by commercial growers.

With this in mind, the new GreenTech Hub at East Malling has been developed with a state-of-the-art infrastructure promoting access to cutting-edge demonstration and research facilities. It includes 1,928 m^2 of specialist glasshouses with compartments ranging from 24 to 352 m^2 in area. This includes seven climate-controlled compartments with both heating and cooling facilities, blackout screens, HPS and LED lighting, misting, automated drip irrigation and fertigation facilities, moveable ebb and flow benches and insect-proofed netted compartments with lockable zones for high-risk pest and disease research.

New laboratories in the Facilities Building

The GreenTech Hub has nine fully enclosed growth rooms

An additional area of fourteen modern polytunnels, each 128 m^2 in area, have also been built to mirror the high-tech tunnels employed by leading commercial growers.

The GreenTech Hub also provides fully enclosed growth rooms. There are nine in total ranging from 10-20 m^2 in area, with independently-controlled environments. Temperature can be varied between 15-38°C, humidity can be controlled and broad-spectrum high intensity LED plant growth lighting has been installed to allow for deep light penetration in dense crops. The rooms also have containment level 2 laboratory design for licenced pathogen work. 35 m^2 and 43 m^2 cold rooms have also been built and can be controlled between -2 and 4°C. A fully equipped laboratory space is also available for sample preparation and processing.

A new viticulture centre has also been set up at East Malling for vine growers to cater for research and development in Southern English conditions and to allow scientists to assess the impact of the agronomic work on subsequent wine quality. A dedicated new winery has been included in the GreenTech Hub

Fourteen new polytunnels offer additional growing space

Nearly 2000m² of specialist glasshouses with climate controlled heating and cooling

with a fermentation and dry goods area and cellar.

So how much will the new GreenTech Hub benefit the collaborative industry/science partnerships being developed by Growing Kent & Medway? The building works will be completed in late April, when the Hub will be open for business. Demand for the glasshouse space is already high and a number of projects, some funded by separate Growing Kent & Medway and industry-commissioned grants, have already been allocated space. The facilities will allow NIAB scientists to investigate problems and develop solutions to the most pressing issues facing growers and food producers today. These include more sustainable crop protection systems, reducing waste and implementing efficient use of resources including water, nutrients and light.

- Climate-controlled glasshouses allow us to investigate biological control agents that are used in Integrated Pest and Disease Management and require optimum temperatures to work successfully. Work on biopesticides can also be done, as these too are sensitive to changes in environmental conditions.
- Temperature and irrigation control allow physiological research to be done on plant adaptive responses to combined stresses, such as high temperatures and limited water availability, to better understand how crops should be managed to help to mitigate impacts of climate change on marketable yields and consistency of fresh produce quality.
- Research into optimising irrigation and fertigation inputs to meet demand with supply for key commercial varieties will underpin the development of more sustainable growing blueprints that use resources more efficiently and reduce emissions to land, air, and water.
- Work will also begin on understanding how biofortification can improve the phytonutrient content of fresh produce, and if these treatments confer resilience to weather-related stresses and pests and diseases.
- Blackout screens and artificial lighting offer the opportunity to investigate differing daylengths and humidities on plant physiology and flowering patterns, yields and plant/fruit quality.
- Light and temperature control allow scientists to assess the rate of flower and fruit development and data gathered can be used to develop models of fruit ripening and plant picking profiles. Such models can be linked to weather forecast data to produce more accurate yield forecasting, something that has challenged growers, marketing groups and retailers for many years and the quest to resolve this continues.
- Controlled growth rooms can be used for experimenting

with different wavelengths of light to assess the effects on plant growth, levels of phytonutrients and impact on plant quality and yield.
- Growth rooms also allow us to quickly establish optimum growing conditions for newly bred cultivars of strawberry and other fruits, as well as experimenting with vertical farming systems which can maximise production in reduced cropping areas.
- The cold room facilities at the Hub allow harvested plants and fruits to be held at the low temperatures used in the commercial cool chain operated by growers and retailers, whilst also being useful for holding plants in optimum condition when they arrive at the Hub and before being planted.

A Client Zone has also been constructed which will enable industry partners and scientists to meet and welcome visitors to learn more about the projects being undertaken. The Zone overlooks the research vineyard and is positioned adjacent to the new winery which can be seen through a viewing gallery.

The new Client Zone offers meeting facilities overlooking the vineyard

Over 100 years may have passed since the first experimental facilities opened for business on the site at East Malling, but with the opening of these exciting new facilities, the aspirations remain unchanged – a desire to sustain and advance horticultural and food production in the south-east of England.

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Take our weed surveys and help us help you

As farming systems and practice changes the effectiveness of weed control continues to be impacted by the progression of herbicide resistance, both within and between species. So there has never been a more important time to monitor, map and understand the status of weeds on farm.

But weed surveys need engagement and involvement of the whole farming sector, from technical experts, advisors and farmers, and the adoption of a range of approaches bringing together different skills and expertise. So when did you last take a weed survey?

Herbicide resistance surveys

Through meetings over the past few years NIAB TAG members will have seen data on some quite unique herbicide resistance surveys.

Wild oats

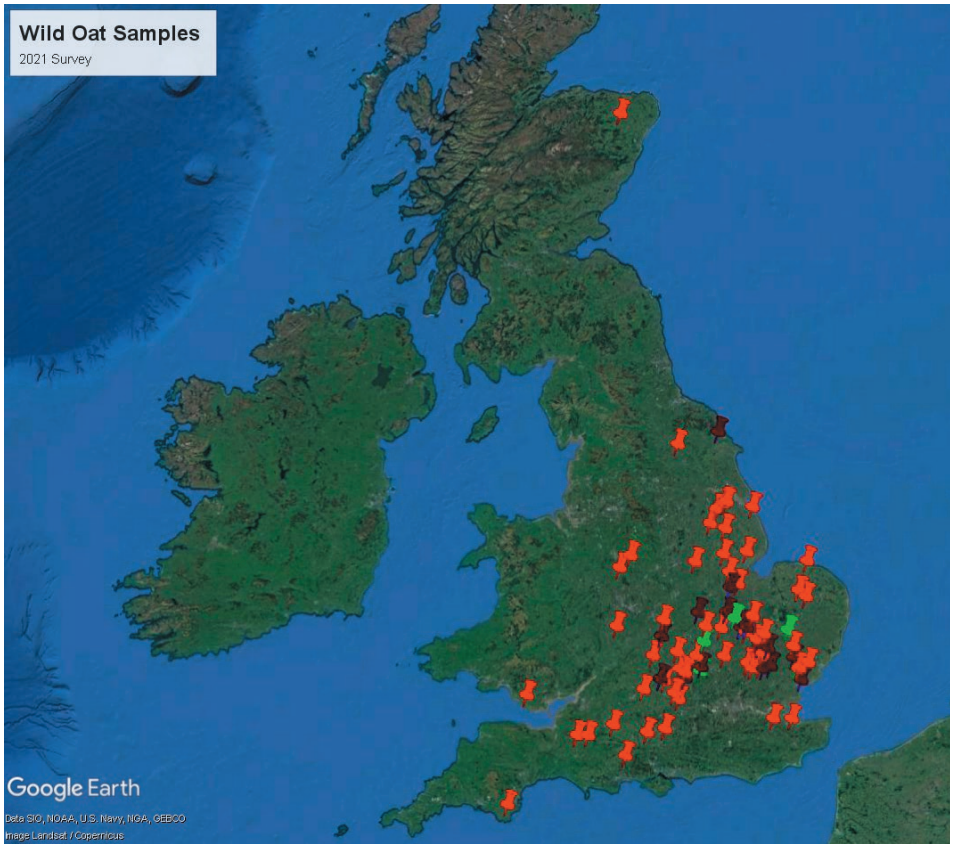
In 2020, in partnership with Life Scientific, NIAB carried out a national wild oat survey that gave an up-to-date understanding of the status of herbicide resistance, and at the same time revealed some insights into the status of wild oats as a UK arable weed.

Wild oats occur in the UK as two quite distinct species with contrasting germination biology – the spring or common wild oat (*Avena fatua*) and the winter wild oat (*Avena sterilis* subspecies *ludoviciana*) (Figures 1 and 2). The survey revealed that the winter wild oat occurs at a much higher frequency than previously thought; nearly a third of the samples in the survey contained winter wild oats which is about a three-fold increase on previous estimates. This observation together with the high

number of mixtures of the two species has enormous practical implications for the practical management of wild oats.

Testing of over 100 wild oat samples also revealed a difference in the frequency of herbicide resistance that can be detected in these two species but Figure 3 shows the data for the two species combined to give an overview of the status of herbicide resistance in UK wild oat populations. There are examples of high levels of herbicide resistance across the full range of contact acting herbicides that highlights the need for on-going testing and monitoring. But it is still the case that the vast majority of wild oat populations in the UK are susceptible to key herbicides. Practically, on-farm, this means that the majority of herbicide failure is down to application timing and conditions around application where we can focus our efforts to optimise control.

Figure 1. Wild oat samples received in 2020 showing the distribution of both wild oat species



Italian ryegrass

Italian ryegrass is a priority weed species in the UK and NIAB has established an Italian ryegrass trials site in Kent (to mirror the Hardwick Black-grass Centre) where we can develop and demonstrate integrated weed management for this weed. One reason that this is such a priority for integrated weed management is the intensity and rate of development of herbicide resistance.

NIAB has carried out two herbicide resistance surveys on Italian ryegrass. The first in 2019 was in partnership with Syngenta, Bayer and BASF. This support from major players developing and supporting crop protection for this weed reflecting the shared concern about the species. In this initial work we asked the question "to what extent does herbicide resistance contribute to difficulty managing the weed effectively in practice". Problematic Italian ryegrass populations were tracked down through NIAB TAG members collecting 50 samples of the most 'difficult' populations. From this initial survey we saw the extent to which problems in managing Italian Ryegrass were down to continuing development of herbicide resistance. However, we also identified the emergence and development on-farm of a new herbicide

Figure 2. A comparison of spring wild oat (*Avena fatua*), on left, and winter wild oat (*Avena sterilis* spp *ludoviciana*) seeds

resistance trait effecting the performance of some pre-emergence herbicides, including flufenacet, which is a key active for the control of the weed.

Most recently, last summer NIAB carried out a more realistic survey, in partnership with Bayer and open to all, asking for seed samples alongside a simple questionnaire to give the essential context to each sample. Preliminary survey results of just under 200 populations are available on some herbicides but the testing is ongoing.

The results so far from both projects have highlighted how vitally important it is to understand the context and approach taken in surveying weeds, and herbicide resistance in particular. All herbicide resistance surveys give skewed results. It is harder to sample weeds where herbicide performance is high, farmers and agronomists are more likely to spend the time sampling seeds where they already suspect herbicide resistance and a number of the samples collected in the field will already have been treated with the very herbicide that they are being tested with.

It is hard to understand the relationship between the frequency of resistance reported in a survey and the true frequency but the two surveys demonstrate how contrasting the result can be from different approaches.

Figure 4 shows the contrasting results from the two surveys for Axial Pro (a.i. pinoxaden). The 2021 survey indicates a much lower overall level of resistance (the percentage of samples with RRR resistance in 2019 was nearly 40% but in 2021 it dropped to 15.9%). These results show how different the result can be from a targeted sampling (on the left) to a mail-in survey (on the right). However, perhaps the challenge is to try and use this information to understand and visualise the third result, further to the right, that reflects the true randomly sampled occurrence of resistance. In the end, there is no substitute for herbicide resistance testing of individual populations.

The detailed results of the 2019 survey have been presented to NIAB TAG members and as the 2021 survey results become available NIAB will be providing essential information on the status of herbicide resistance in Italian ryegrass and promoting best practice in its integrated management.

Figure 3. Frequency of occurrence of herbicide resistance observed in wild oat samples (2020). R ratings summarise the intensity of herbicide resistance in an individual sample: RRR "resistance confirmed, highly likely to reduce herbicide performance", RR "Resistance confirmed, probably reducing herbicide performance" and R? "Early indications that resistance may be developing, possibly reducing herbicide performance". The S populations are fully susceptible

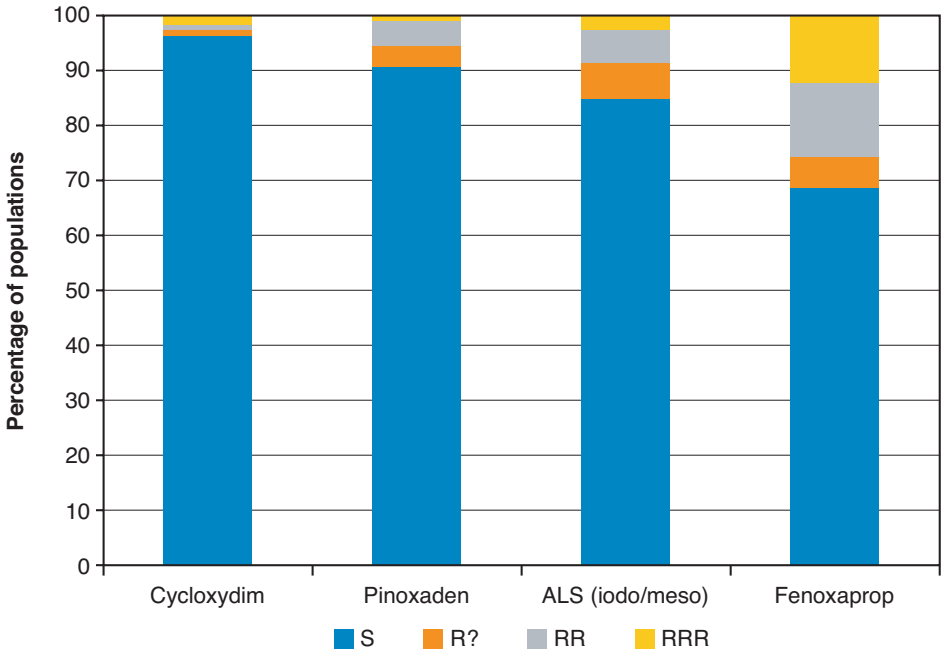
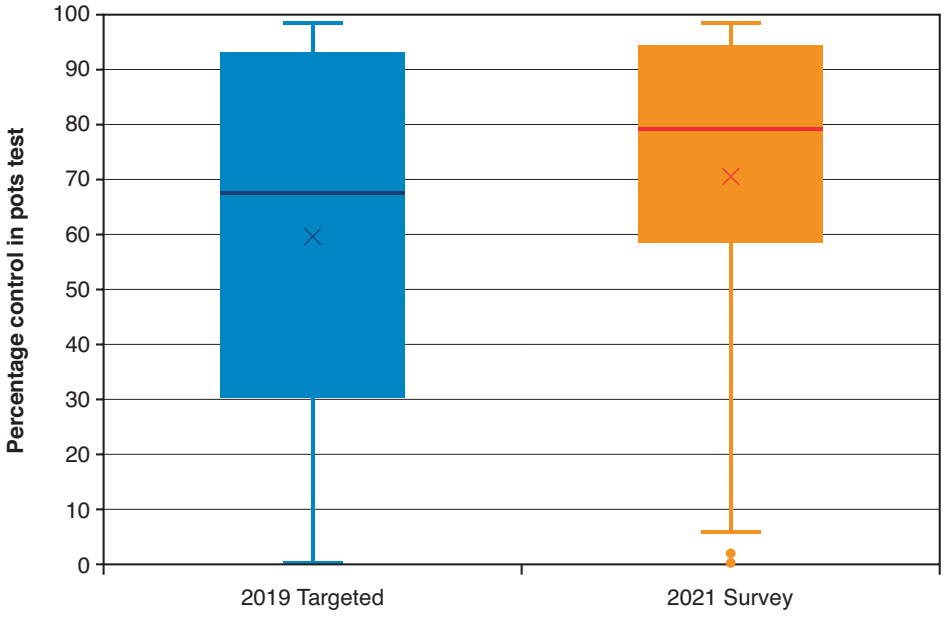


Figure 4. Comparing the overall level of control observed using Axial Pro (a.i. pinoxaden) on samples collected in 2019 and 2021



Baseline surveys – herbicide resistance surveys with no herbicide resistance

One aspect of NIAB's work has involved surveying weed species where there are no current cases of herbicide resistance. By understanding new weed problems in evolving agricultural systems and identifying where there is an over-reliance on particular herbicides, efforts can be focused on high herbicide resistance risk scenarios as they develop. Usually, these proactive emerging weed baseline surveys involve a lot of effort for very little short-term gain, but this work is essential to try to address problems as they develop rather than waiting until they become a significant threat to crop production.

NIAB has identified two emerging and developing weed species as an immediate priority; Bur Chervil (*Anthriscus caucalis*) and Rat's Tailed Fescue (*Vulpia myuros*). These species are clearly associated with the adoption of reduced tillage as part of the move to conservation agriculture and for both species growers are particularly reliant on one group of herbicides to maintain control in the soil conservation agriculture systems. Establishing a baseline for sensitivity to those herbicide is a priority so over the 2020 and 2021 season, through the network of NIAB TAG members, samples were identified and obtained from across the country of both species (Figure 5) and testing is currently taking place at NIAB Park Farm (Figure 6).

For these emerging weeds of conservation agriculture the baseline surveys for Bur Chervil and Rat's Tailed Fescue, alongside a number of other weeds, go alongside work in NIAB's field trials programme on cultural control and crop protection strategies. In the case of herbicide studies reviewing options to diversify and reduce reliance on particular groups of herbicides has been the priority. Changes in arable rotations and systems are an opportunity to support better management of existing weed problems but at the same time we need to be pro-active and understand the nature of weed management issues as they develop.

Figure 5. Sample locations of Bur Chervil (*Anthriscus caucalis*) as part of baseline survey work at NIAB

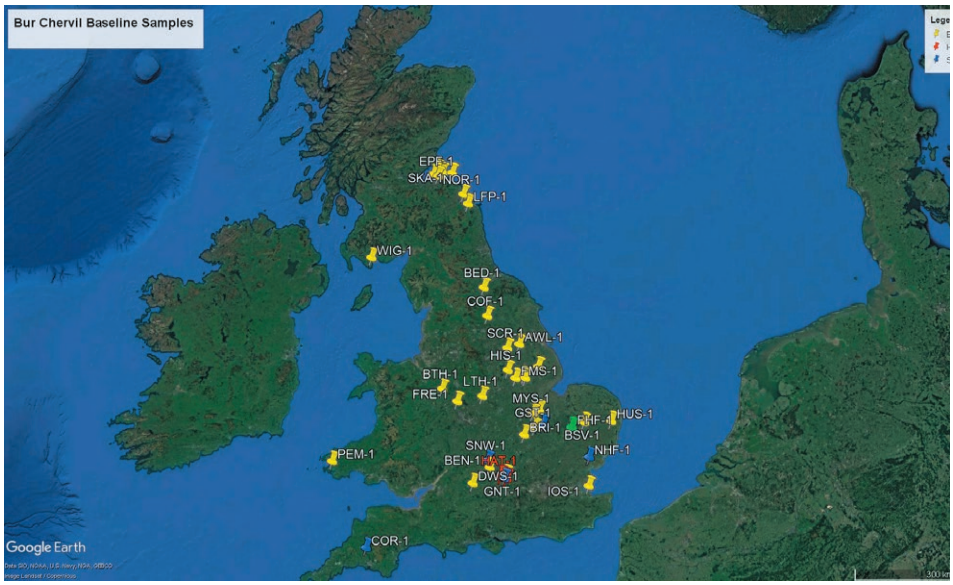


Figure 6. A baseline assessment of *Vulpia myuros* and *V. bromoides* sensitivity to Atlantis (a.i. iodosulfuron-methyl-sodium + medosulfuron-methyl) and a.i. glyphosate in the glasshouse at NIAB Park Farm

How do we systematically survey for weeds nationally?

Changes to the crops grown in the UK and the way that they are being grown inevitably change the nature of weed management challenges and, as seen with species like Bur Chervil and Rat's Tail Fescue, can lead to the emergence of different weed species. The surveys NIAB has carried out to date have focused on problematic weeds and emerging issues in no-til systems. These species reflect the feedback from NIAB TAG members on weed management in practice, but how do we spot trends and before they become a problem on farm?

Random surveying of weeds in arable fields at sufficient scale to pick up weed species as they emerge is difficult to imagine but working with colleagues in OSTS we are exploring the possibility of using information gained from the enormous number of crop grain samples – could weed seed contamination in crop grain be a way of surveying weeds at sufficient scale to spot these emerging problems?

Send us your samples

If changes in weed issues are being found, associated with conservation agriculture practice, please get in touch (John Cussans – john.cussans@niab.com). If farmers and agronomists have Bur Chervil and/or Rat's Tailed Fescue on-farm NIAB would welcome another sample for the baseline work.

NIAB does offer a commercial herbicide resistance testing service – go to niab.com/services/laboratory and NIAB LabTest.

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Discovering Agritech

Landmark's **Discovering Agritech** feature shines a spotlight on the projects and businesses working with NIAB to offer innovative and sustainable solutions to the food and farming sector, both in the UK and globally.

Two enterprises are featured in each issue, giving them an opportunity to outline their vision and plans for new products and services – this month it is **Cambond Ltd** and **Antobot**.

BARN4 AGRITECH INCUBATOR

Through initiatives such as Barn4, the Eastern Agri-Tech Innovation Hub, Growing Kent & Medway and Cambridge AgriTech, NIAB is committed to creating, developing and supporting new commercial activity across the agricultural or horticultural sectors. Delivery is through licenses, consultancy, access to facilities, training and agritech products or services and across our activities we are able to reach into NIAB's global industry networks, its science, and its talent pool to access the resources and skills we need.

Developing mutually beneficial relationships with small and medium-sized enterprises (SMEs) and their investors in the agritech sector is an important focus for NIAB, working closely with the sector to explore new business models and support delivery of innovation for the industry.

Turning other people's waste into our resource for a better world

CAMBOND

Tell us about your company, what it does and what are you trying to achieve?

Cambond is a Cambridge-based UK company working on the 'sticky business' of turning food and agricultural waste into a plant-based resin. This can be used as an adhesive or binder to make low carbon composite materials for circular economy.

Modern construction materials are often made from engineered wood (plywoods, medium density fibreboards, oriented strand boards). These materials are made by mixing wood fibres with urea-formaldehyde glues and heating them to make boards. However, the urea-formaldehyde glues are toxic and oil-based. Their manufacture requires copious amounts of energy in a complex process, the residues in wood products can give 'off gassing' of noxious vapours (contributing to 'sick building syndrome') and result in re-cycling difficulties.

Cambond's resin is made from

Dried Distiller's Grains and Solutes (DDGS), a by-product of whisky distillation or bioethanol production. DDGS is a familiar ingredient in agriculture as it is widely used as an animal feed. We use DDGS to make resin in a patented process which is safe, low carbon and environmentally sustainable. Cambond resin can be used to completely replace urea formaldehyde in the manufacture of different construction boards.

We have shown that we can take an abundant natural by-product and use it to replace toxic oil-based chemicals in construction materials. We can use readily available agricultural non-wood fibres such as straw, hemp fibre or bamboo to make carbon-negative materials for many different applications. We harness the complex chemistry of plants and energy from the sun to provide a globally useful and sustainable substitute for toxic oil-based chemicals.

How does your product or service benefit the agricultural industry or the wider-world?

Cambond has undertaken a wide-ranging development programme to explore the uses of the resin to make environmentally friendly materials. The resin has been combined with non-wood fibres from straw, nut shells, pineapple tops, used coffee grounds, palm oil-wastes and other agricultural by-products to produce bio-composite construction materials

(MDF-type boards). The agricultural by-products make a great wood substitute. These types of construction materials are sustainable, cheap and may be the world's cheapest carbon capture technology.

We can go further and use these biomaterials to make moulded or formed products like plates, trays and bowls. As 100% biomass they make an excellent alternative to plastics like melamine or polypropylene and have been shown to meet FDA (US) and EU requirements for food safety.

Cambond is in the process of demonstrating these innovative materials to potential customers and have set up a development facility at NIAB's Eastern Agritech Innovation Hub in Soham, Ely.

How are you working with, or supported by, NIAB?

Cambond have been exploring ways to extend the use of this technology. An interesting development has been the use of the bio-resin as a component in creating an 'organic' seed coating technology. This approach would avoid the use of plastics or oil-based resin in seed coatings and provide a more sustainable approach for this branch of agricultural technology. Cambond has been working with NIAB to carry out initial seed growth trials and assessments. This technology looks extremely promising and is likely to form the basis of a spin out company – Seed360 Innovation Ltd.

Why did you join the Eastern-AgriTech Innovation Hub? How important have they been for developing and supporting your start-up?

The Hub share a vision with Cambond and is striving to achieve to reduce and repurpose food and plastic waste. It provides a great environment to work with like-minded business owners and fellow companies to build our social capital for investment. It has proved the ideal place to gather and deliver our development activities, and to showcase applications and samples. Additionally, the Hub 'plugs' Cambond into the agricultural community and has enabled us to find new partners to provided expertise, materials, and development partners to speed up our business growth in UK.

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Affordable robotics for a sustainable agriculture

Tell us about your company, what it does and what are you trying to achieve?

Antobot is an award-winning start-up developing affordable robotics for sustainable agriculture. We have an international team of 20 people split between Chelmsford, Essex and Shanghai, China.

We believe that robotics should be accessible to all farms, big and small, so we are developing our tech with affordability in mind starting with development in the soft fruit and top fruit industries in the UK. We are fully vertically integrated with teams working on robotics hardware, software, and our unique one-of-a-kind control system the universal Robot Control Unit® which recently won an award as top 21 to watch technology for 2022.

Our vision is a fully autonomous farm to help agriculture be more economically, environmentally, and socially sustainable through filling the current labour gap, upskilling rural employment and attracting younger talent to agritech. Our robots are optimised for agriculture with a rugged, modular yet lightweight design allowing for cost savings and minimising soil damage usually created by heavy diesel-based machinery.

We also have two ongoing projects with government innovation funding working on our Insight data service and drone-robot integration.

How does your product or service benefit the agricultural industry or the wider-world?

We are currently pursuing three launch products, but we are flexible in our product development timeline due to our focus on creating a modular platform and control unit that can adapt to suit any farmers' needs. We would encourage anyone that has an idea or problem they would like solved on their farm to get in touch with us – we are always looking for new, innovative ideas and farmer collaborations!

Insight

Insight is our autonomous mobile data robot which travels around the farm collecting timely and rich data on the produce growing there, including size, ripeness and number with algorithms currently developed in strawberry and apple farms. Our partner farms fed back to us that they do not have the manpower to consistently scout their farms and deliver the information they need. The ability to access this data will enable data-led decisions on variable-rate application of inputs and better estimations of yield that will improve on-farm efficiency as well as building the knowledge needed for further technological development and yield estimation modelling. We aim to expand this service to early detection of pests and diseases in order to prevent widespread crop loss.

Assist

Assist is our co-bot that aims to work with fruit pickers to fill the gap in labour supply that is particularly prevalent in the UK due to the challenges of Brexit and the pandemic. Harvesting technology is not yet comparable to human pickers so this autonomous platform aims to transport empty and full produce trays to decrease the amount of non-productive time pickers spend transporting produce, as well as serving as general logistical assistance during the harvest season.

uRCU®

Our Universal Robot Control Unit (uRCU®) is our core technology which combines all modules needed for robotic control into one unit at a fraction of the price designed for agricultural robots and beyond. We are keen for the uRCU® to become a common based hardware control system for other robotic start-ups to accelerate the pace of innovation in the sector.

How are you working with, or supported by, NIAB?

We are currently working with NIAB through the Barn4 incubator and NIAB at East Malling. Both teams have already provided great advice and insights and we are currently in discussions on how we can work together on future collaborations and projects.

Why did you join the Barn4? How important have they been for developing and supporting your start-up?

Barn4 has brilliant knowledge and connections to other companies within the sector, particularly within horticulture where our initial focus lies. They also provide access to testing facilities which we are looking forward to using in the growing season. Through membership we have access to world-class expertise and experience in relevant sectors which cannot be replicated anywhere else in our opinion.

Antobot

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Dr Charlotte Nellist • charlotte.nellist@niab.com

UKCPVS: First stage of results from the 2021 season

Yellow rust genotyping is now well established within the Survey and a single genetic group (the Red Group) has dominated for the past three years. Last year UKCPVS received fewer yellow and brown rust disease samples than the previous year; probably due to the cooler temperatures in April and the excessive rain and storms in May. Though not part of the Survey, the 2021 season saw a bumper year for Septoria, infecting varieties with Cougar in their parentage; a variant first investigated in a previous AHDB project at NIAB.

The current situation: wheat yellow rust

UKCPVS received around half of the number of yellow rust samples in 2021, 155 samples, compared to the 2020 season, 306 samples. The 2021 season started off normally, with yellow rust starting to develop in March, with double the number of samples received that month compared to the same time in 2020.

However, April was drier and on average 2°C cooler across the UK, which held back disease development and sample numbers plummeted. The heavy rain and storms in May corresponded with a fall in sample numbers. In June, as more favourable weather conditions returned, there was an increase in yellow rust and UKCPVS received 77 samples that month. The disease season was, therefore, very short and sharp with yellow rust rapidly drying up and dying off by the end of June.

Yellow rust samples were received from 19 English counties with most samples, unsurprisingly, received from Lincolnshire, then Cambridgeshire and Essex. However, UKCPVS also received samples from traditionally lower risk areas for yellow rust, such as Scotland, Wales and Devon, covering a wide geographical area.

Despite, the overall lower number of samples received during the season, 54 different varieties were still represented. Similar to 2020, the most prominent variety was KWS Firefly; its AHDB Recommended List rating has fallen from the 2019/2020 rating of 9 to a 2022/2023 rating of 6. As with the 2020 Survey, most samples were received in the cooler months March-April. Further tests of two isolates from KWS Firefly from the 2021 Survey, conducted at the reduced temperature of 12°C day/10°C night, did see much better sporulation and increased susceptibility, possibly indicating that seedlings of KWS Firefly are more vulnerable to yellow rust at cooler temperatures. Four samples with very low infection levels were received from KWS Siskin (RL rating 9). However, none of the isolates reinfected KWS Siskin at the seedling stage, confirming that this resistance remains stable.

UKCPVS

The UK Cereal Pathogen Virulence Survey (UKCPVS), managed by NIAB and jointly funded by AHDB and APHA, monitors the populations of the important cereal pathogens *Puccinia striiformis* f.sp. *tritici*, causing wheat yellow rust, *Puccinia triticina* causing wheat brown rust, *Blumeria graminis* f.sp. *tritici* causing wheat powdery mildew and *Blumeria graminis* f.sp. *hordei* causing barley powdery mildew. The Survey was established in 1967 following an unexpected outbreak of yellow rust on the previously resistant wheat variety Rothwell Perdix and has since provided valuable insight into the surveyed pathogen populations in the UK.

Figure 1. The preliminary phylogenetic tree in the centre of Figure 1 depicts the relationship between isolates and the outside of the circle depicts a heatmap of the presence (red) or absence (green) of virulence on the differential. The Red Group has dominated for the past three years, with only a few isolates detected from the Pink and Purple Group

Figure 2. Early season development of yellow rust and septoria at the RL untreated demo plots on the NIAB trial ground at Cambridge in March 2022

Using seedling tests, the virulence profile for a selection of isolates was determined. Virulence for Yr1, 2, 3, 4, 6, 7, 9, 17, 25, 32 all remained very high in the population with a slight dip in virulence for Yr3 and Yr4. Virulence for Yr8 is the one to keep a close eye on as that has been seen at low levels, but did peak in 2019 with 15% of isolates. However, it was found in only 8% of isolates tested in 2021. No virulence was detected for Yr5, 10, 15 or 24.

Key additional non-AHDB Recommended varieties were included in tests. Noteworthy ones include virulence on Cadenza, which was seen in almost 90% of isolates tested in 2021, and virulence for Apache reached 100%. Virulence to Evolution has fluctuated the most over the past five years and was seen in 38% of isolates in 2021, similar to the levels seen in 2018. Virulence for Kranich was not seen in isolates tested in 2018 but has climbed since then to 45% of isolates. Virulence for Crusoe remains at low levels, detected in 3% of isolates.

Seven new pathotypes were identified during 2021, with one isolate combining virulence for Yr8 and Crusoe. New pathotypes were detected across the country, highlighting the need to gather representative samples from around the UK to get an accurate picture of what is happening in the yellow rust populations. The risk to UK varieties from these new pathotypes will be investigated further in adult plant trials conducted in 2022.

Looking ahead to the 2022 season, at the time of writing, only six samples have been received by the UKCPVS team, compared to the 54 samples at the same time last year. This may be deceiving as there is plenty of yellow rust out and about. Growers are advised to monitor all varieties carefully this season and to report unusual levels of disease to UKCPVS as soon as possible.

Genotyping yellow rust isolates

UKCPVS has deployed routine genotyping of wheat yellow rust isolates, based on John Innes Centre's Dr Diane Saunders' MARPLE pipeline (Mobile and Real time PLant disEase diagnostics). Genotyping is categorising an individual, based on its collection of genes. Focusing on 242 highly variable genes that are informative for distinguishing individual yellow rust lineages, a selection of isolates from 2019, 2020 and 2021 were sequenced and the relationship between them and reference isolates was examined (Figure 1).

The Red Group, previously known as Warrior 4 or Warrior(-), has dominated for the past three years. 48 of the 155 samples in 2021 were genotyped and all belonged to the Red Group. There was a broad range of virulence profiles within the Group. Genotyping has helped identify unusual isolates from the Pink Group (Warrior) and Purple (Kranich) Group in previous years. We will continue to genotype a selection of isolates in the 2022 season.

Septoria

Unexpectedly high levels of *Zymoseptoria tritici* were observed in 2021, with reports of some varieties with Cougar in their parentage (KWS Firefly and KWS Saki) showing higher levels of septoria and a greater reduction in yield.

Growers are advised to consider other management practices this season as the RL ratings of some varieties have fallen. However, plant resistance is only 'one string in the bow' and reducing disease pressure with the correct timings of preventative fungicide applications, considering drill timing and location and spreading risk by growing diverse varieties, are all advised proactive management plans.

Looking to the 2022 season, there is already currently plenty of septoria out there due to the mild winter (Figure 2).

Send us your rust samples

UKCPVS relies on samples of interest sent in by growers, agronomists and breeders. We welcome wheat yellow and brown rust and wheat and barley mildew samples from all RL and RL candidate varieties from across the country. Full sampling details are available on niab.com via Research/ Agricultural crop research/Research projects/UKCPVS. Further details on sampling can be obtained from Charlotte Nellist (charlotte.nellist@niab.com or 01223 342200).

Farm Diary

Around 40 minutes east of Edinburgh, close to the coastal town of Dunbar, is Bielgrange Farm. Here, NIAB TAG member Niall Jeffrey manages the 300 ha arable farm in the fertile East Lothian region plus a 240 ha hill farm in the nearby Lammermuir Hills. The farming operation also includes two contract farms: 75 ha of arable, and a further 1,000 ha hill farm.

"The two main enterprises of beef and cereals complement each other well," explains Niall, who is assisted by three staff and one part-time manager; Niall's father Angus. The farm mainly produces distilling wheat and malting barley for the Scottish market, but sometimes Niall sells direct off the field to livestock farmers. The soil is predominantly clay loam, with Niall employing a five-year rotation of oilseed rape, winter wheat, spring barley, winter wheat and finally winter barley.

"We've tried a bit of everything here over the years! I've tried a bit of cover cropping, direct drilling, strip tilling; I still have a plough because I plough every five years," he adds. "We've quite a moderate input system here, which means we carry out a mixture of non-inversion and ploughing tillage." They stopped using bagged P & K fertiliser three years ago, switching to using locally produced compost and home-produced farm manure.

There are a couple of things that make the business stand out. Every year, Niall carries out a full accounts disclosure benchmarking with a group of other local farmers. "It's really interesting. We share our profits and/or losses with them; it's a quite open group. Having to present your accounts annually to a group helps focus on cost control and improve on business profitability," he says.

Testing innovation on the farm

Bielgrange is a satellite farm for the Agricultural Engineering Precision Innovation (Agri-EPI) Centre – one of four Agri-Tech Centres funded as part of the Government's Agritech Strategy. The satellite farms provide a testbed for the next generation of farming techniques and technology, including sensors, imaging and robotics, with commercial trials taking place within a UK-wide network of 28 satellite farms.

Although originally introduced as a beef satellite farmer, there is some technology that Niall is using on the arable side. "Through the Agri-EPI Centre, we work with companies that are trying different things and new technologies and we give them our honest commercial 'can we break out on a farm?' opinion," he explains. "We've won a few awards on the livestock side including the Marks and Spencer Farm for the Future 2013, Scotch Beef Farm of the Year 2018 and a Farmers Weekly Beef Farmer of the Year Award runner up in 2019. Marks and Spencer put us forward for the Agri-EPI Centre, which gave us access to a few different software and field mapping platforms we could use on the arable side. It meant we got to try all of them and not go down one route, and they gave us a drone! I started carrying out crop surveys with crop modelling company Omega Crop alongside wheat yield estimations and establishment counts with them. That's something a bit innovative.

Benefits of NIAB TAG membership

Niall completed his BASIS training in 2009 and originally joined NIAB TAG to gain CPD points. "As much as I'd just completed the course, I quickly realised I didn't have a clue about putting it into practice in the real world and how it works! I've learnt a lot from the other Berwick Group farmer members, and our regional agronomist Patrick Stephenson, especially on field days.

He highlights the trials results and Agronomy Strategy documents as his main decision-making tools. "When planning my crop management programme the first step is the Agronomy Strategy document – it's such a helpful resource."

For example, he has two questions when a new product comes to market – does it work and is it worth the money? "That's when NIAB TAG Membership comes into its own. With herbicides and fungicides, I can check the dose response curves from NIAB TAG before proceeding. And it's great that I can phone Patrick, whenever I need, but I find going to the meetings and field days very useful; there is a good group at Berwick, with a lot of farmer-to-farmer knowledge transfer going on," finishes Niall.

NIAB

NIAB TAG

Summer Events 2022

Find us at key industry events

CEREALS EVENT • Wednesday 8 & Thursday 9 June
CHRISHILL GRANGE, CAMBRIDGESHIRE

GROUNDSWELL • Wednesday 22 & Thursday 23 June
HITCHIN, HERTFORDSHIRE

AGRISOUTH • Thursday 30 June
FAVERSHAM, KENT

Free and open-to-all
Book your place at NIAB Open Days

Featuring variety and agronomy demo plots, advice and research

SOUTH • Tuesday 14 June
SUTTON SCOTNEY, HAMPSHIRE

EAST • Thursday 16 June
IN ASSOCIATION WITH TMAF, MORLEY, NORFOLK

STAR • Monday 20 June
(ARABLE ROTATIONS, CULTIVATIONS AND SOILS) IN SUFFOLK

CAMBRIDGE • Tuesday 28 June
HINXTON, CAMBRIDGESHIRE

NORTH • Thursday 30 June
IN ASSOCIATION WITH CROFT FARMS, CROFT, CO DURHAM

Visit niab.com/niab-event-hub for event details and registration

NIAB TAG members have exclusive access to additional regional cereal variety and agronomy days at our Cirencester, Kingsbridge and Warwick regional trials sites, plus specialist events at Cambridge-Hinxton (OSR), Faversham (ryegrass), Hardwick (black-grass), Corringham (black-grass) and Cambridge-Hinxton (broad-leaved weeds).

Please check the NIAB TAG Membership website for more details, dates and booking.

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