NIAB
Issue 55 • Spring 2024

Landmark

A summer of plant science into practice

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The importance of translating plant science into practice

Professor Mario Caccamo is NIAB Chief Executive appointed in October 2021. He originally joined NIAB as the Head of Crop Bioinformatics in 2015 before taking the position of Managing Director of NIAB EMR in 2017. A computer scientist by training, Mario has over 20 years' experience in life science research and big data, including specific projects to apply the latest DNA sequencing technologies and bioinformatics methods to advance scientific understanding of crop genetics and the interaction of agricultural crops with their environment.

There is a long-term, well-documented imbalance between public funding of fundamental crop science, in which the UK punches well above its weight, and support for the translational and applied research needed to unlock the real-world potential of this discovery science via practical, on-farm advances. So, while the UK ranks third in the world only behind China and the US for high-impact academic publications in agricultural science, growth in domestic agricultural productivity lags behind most other developed economies.

But the pace of change is accelerating. Faced with an urgent need to produce more and better with less, while improving soil health and responding to urgent climate and biodiversity goals, this discrepancy in funding between fundamental and applied agriculture related research must be addressed. We also need a strategic review of whether the current structure of the UK's applied crop science capabilities is fit-for-purpose.

There may be lessons to learn from NIAB's journey over the past 20 years, after transitioning from a non-departmental public body to become an independent charity. Prior to that, the majority of NIAB's funding came from Government, and our primary focus was on providing science-based technical and statutory services to UK agriculture departments and the seed industry.

While variety and seed testing remain core to NIAB's operation today, at the time government funding for such services declined significantly with a switch to full cost recovery following the Barnes Review in the mid-1980s. Because of this, NIAB's future viability was in serious doubt.

Since the mid-2000s, NIAB has made substantial investments in the development of skilled staff and scientific facilities including new laboratories, glasshouses, growth rooms and field trial equipment. This supported a diversification of our research base, building on our core strengths in seed testing and plant variety evaluation to develop scientific capabilities spanning the entire crop improvement pipeline, from genomic research and pre-breeding to applied agronomy, soil and environmental science, data and precision farming, training and knowledge transfer onto farm.

At the same time, NIAB has forged new partnerships, including a strategic merger with The Arable Group (TAG) to become the UK's largest independent provider of applied agronomy research and knowledge transfer onto farm, acquisition of the Potato Agronomy Unit from Cambridge University, and the merger with East Malling Research in Kent, safeguarding world-renowned expertise in soft and top fruit crop research and breeding, now diversified to include viticulture, water efficient crop production and biological pest control.

In 2020, in partnership with the University of Cambridge, we launched the Crop Science Centre with the objective to combine our collective expertise, creating a space for impactful research excellence with the capability to apply crop improvements in the field, and the mission to make global food production more equitable, sustainable and resilient.

Through these strategic investments and partnerships, NIAB has trebled in size over the past 15 years to become one of the UK's leading independent applied crop research and knowledge transfer organisations, employing more than 350 highly skilled staff and with a critical inter-connecting role in the R&D landscape between the science base, farmers and the agri-food supply chain.

According to independent economic impact research, for every £1 spent on research at NIAB, at least £17.60 is returned to the UK economy through improved production efficiency, economic growth, import substitution, export earnings and inward investment. But it is indicative of the imbalance between Government funding of fundamental and applied crop research that these investments were financed almost exclusively from NIAB's own resources with support from private charitable funds.

The UK's applied crop science landscape is extremely fragmented, with a number of public, private and third sector organisations all competing in broadly the same funding arena. Competition and diversity are important, but not if they compromise our ability to make progress at the required pace.

This is unlike many other countries around the world, where specific initiatives and organisations are recognised (and rewarded) as national centres of excellence in applied research, and as successful incubators of commercial spin-outs and joint ventures. The food innovation cluster around Wageningen University in the Netherlands, the translation ecosystems established in Belgium by VIB, Saskatchewan's Agri-Food Innovation Centre in Canada, as well as national agricultural research organisations such CSIRO in Australia, and Embrapa in Brazil, are all examples of initiatives in which a focus on research and innovation with commercial impact has attracted substantial private sector co-investment.

Investing in agritech

I recently attended agritech investors events in the US and Belgium supported by public-private partnership initiatives that seek to promote economic activity in the sector. One of the events was hosted in the city of St Louis in the US in which the solid foundations provided by research organisations such as Washington University and the Danforth Centre provides the framework to support innovation delivered at scale.

The second event was organised by VIB, KeyGene and CEPLAS in Ghent (Belgium). This is an annual meeting about the business drivers behind crop innovation. The meeting had presentations from scientists, technologists, and investors with a theme focused on the interplay between technological innovation and market developments. It was refreshing to see the emphasis they put on the development of initiatives supported by credible business cases.

Set against these examples, and the urgent challenge of securing our future food supply more sustainably, in the face of climate change and declining natural resources, is it time to review whether the UK's fragmented approach to applied crop science needs reform?

Moving toward a more coherent national centre of excellence does not necessarily mean on a single physical campus, as NIAB has demonstrated with the successful integration of East Malling Research in Kent alongside our operations in Cambridge.

But I believe the time has come to consider whether a national applied crop science organisation, with combined strengths along the length of the crop improvement pipeline, would better serve the needs of UK agriculture, as well as having the knowledge-base, critical mass and scale to attract inward investment and forge international research partnerships.

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Cereal candidates 2024

80 YEARS RL 1944-2024

With a continual flow of new additions to the AHDB Recommended Lists there is also a continual flow of candidates coming through the system and begging for attention at open days throughout the summer. This year is no exception, in fact it is a bumper year for candidates in both winter wheat and barley, with many available to view on the NIAB stand at the 2024 Cereals Event and NIAB Open Days this summer.

Clare Leaman has worked in variety evaluation at NIAB for over 30 years. For the majority of this time Clare has worked with combinable crops and more recently focused on cereals. Much of Clare's work revolves around knowledge transfer within the industry both through the NIAB membership as well as to a much wider audience. Translating data and trial information into a digestible format for the growers and agronomists to use on the front line is a high priority. Clare is widely regarded as a key source of independent variety advice to growers.

Wheat

With 23 candidates, winter wheat boasts the largest number of candidates I think we have ever seen with a healthy selection in each of the end-use groups. Starting with bread-making varieties we must remember that at this stage they are not categorised in Group 1 or Group 2, so we just have a steer on quality from the breeders.

Of the varieties with data currently available **KWS Arnie** (KWS) offers moderate bread-making quality alongside a high treated yield competitive with feed varieties. The untreated yield is also high, with good resistance to both yellow rust and Septoria as well as a high specific weight. **KWS Newbie** (KWS) again offers moderate bread-making quality but with a slightly lower treated yield. Its untreated yield is still high with good yellow rust and eyespot resistance and a high Hagberg Falling Number (HFN). **KWS Equipe** (KWS) has a similar yield and quality but is very much an Extase type. It offers a very high untreated yield with good resistance to both yellow rust and Septoria, tall stiff straw and early maturity. This is accompanied by a high HFN and good specific weight. **LG Shergar** (Limagrain) also offers moderate bread-making quality with a high untreated yield, good Septoria resistance and a high specific weight.

Four varieties with potential bread-making quality are still waiting to complete statutory Variety Listing (formerly National Listing) and so no data is available at the time of writing. **KWS Vibe** (KWS) and **KWS Beste** (KWS) are hoped to have good bread-making quality which will be of interest to Group 1 growers. **Diamond** (DSV) and **RGT Goldfinch** (RAGT) are more likely to be in the moderate bread-making group, with Diamond bringing orange wheat blossom midge (OWBM) resistance in a bread-making background and RGT Goldfinch bringing barley yellow dwarf virus (BYDV) resistance to quality wheats for the first time; both offer growers the chance to manage risk and still aim for a quality market.

Group 3 growers have seen the opportunities in the group change hugely with Bamford entering the market last autumn with a step change in yield potential. As far as the candidates go with this type of quality a new, high bar has been set. **KWS Solitaire** (KWS) certainly looks to have the yield potential, both treated and untreated, to be a contender. It has good resistance to yellow rust, Septoria and eyespot as well as OWBM resistance. **KWS Flute** (KWS) is slightly lower yielding with good Septoria, OWBM resistance and a good specific weight. **LG Henri** (Limagrain) has a high untreated yield with good resistance to yellow rust and OWBM. **Frenzy** (Elsoms) and **Energy** (Elsoms) are trailing slightly on treated yield, but Frenzy offers good Septoria resistance whilst Energy offers a high untreated yield, good yellow rust resistance and both have resistance to OWBM.

Out of eight hard feed candidates five offer a highly competitive treated yield with the other three just 1% behind. **SY Monza** (Syngenta) looks early to ripen and has very good resistance to eyespot as well as OWBM but has only moderate resistance to yellow rust and some susceptibility to brown rust. **KWS Mongoose** (KWS) offers a good untreated yield coupled with good resistance to both yellow rust and Septoria, OWBM resistance and a good specific weight. **Riley** (Senova) also offers good resistance to both yellow rust and Septoria although has shown some susceptibility to brown rust. **Rufus** (Senova) looks very susceptible to brown rust although it does offer good yellow rust resistance and OWBM resistance.

LG Rebellion (Limagrain) looks very competitive with its high treated yield coupled with a very high untreated yield, 4% above that of KWS Extase, as well as good resistance to yellow rust, Septoria and eyespot. It looks early to ripen and has a high specific weight. **KWS Scope** (KWS) has a moderate disease profile with OWBM resistance and a good specific weight whilst **Memphis** (Senova) has high untreated yield with good resistance to both yellow rust and Septoria. **Roma** (Syngenta), the last of the hard feeds, also offers a high untreated yield coupled with good yellow rust and Septoria resistance as well as OWBM resistance but has shown some susceptibility to brown rust. It also has a high specific weight.

There are only two soft feed candidates this year. **RGT Hexton** (RAGT) offers good Septoria resistance as well as resistance to

OWBM, whilst **KWS Vicarage** (KWS) has good resistance to both yellow rust and Septoria as well as OWBM resistance

A huge choice and not always easy to pick out the front runners when data is so similar, but at the current time the ones to follow appear to be the two good quality bread-makers we are still waiting data for, KWS Vibe and KWS Beste, RGT Goldfinch, for its combination of bread-making quality and BYDV resistance, and KWS Solitaire – plus LG Rebellion with its all-round appeal and KWS Mongoose. Harvest 2024 could, of course, change all this so keep a close eye on things.

Moving on to spring wheat there are six candidates, four with bread-making quality and two feeds. **WPB Lynx** (KWS) is a very high yielding quality variety with excellent Septoria resistance and a good HFN and specific weight. **KWS Jordum** (KWS), another quality variety, is slightly lower yielding but also offers a good HFN and specific weight. **STR Osprey** (Agrovista) and **KWS Bezique** (KWS) are also quality varieties but are still waiting to complete statutory Variety Listing and so no data is available at the time of writing. **WPB Fraser** (Limagrain) is a high yielding feed variety with good yellow rust resistance whilst the second feed variety **Ophelia** (Elsoms) is also waiting for addition to the Variety List.

Barley

Like winter wheat there are a huge number of winter barley candidates, 17 in total and all aimed at the feed market.

We have ten two-row feed candidates with seven having a treated yield up with best current two-row varieties. **Russo** (Agrii) also offers a high untreated yield and moderate disease profile. **Kitty** (Senova) has a moderate disease profile but an advantage in offering resistance to barley yellow mosaic virus (BaYMV) strain 1 and strain 2; most varieties only offer resistance to strain 1. It also has a very good specific weight.

SU Arion (Saaten Union) offers a high untreated yield and good mildew resistance, but has shown low levels of lodging as well as higher levels of brackling. **KWS Heraclis** (KWS) has a high untreated yield as does **KWS Valencis** (KWS). **NOS Olena** (Senova) is also in this high yielding group, as are **Aretha** (Cope) and **SU Newmarket** (Saaten Union). Aretha has shown some brackling, which may well be linked to its early maturity, whilst SU Newmarket offers a good specific weight but is very susceptible to Rhynchosporium. Both Aretha and SU Newmarket offer resistance to both BaYMV strain 1 and 2 although Aretha does not have resistance to BaMMV.

Bastion (Agrovista) is just behind on treated yield but offers a good untreated yield. **LG Carpenter** (Limagrain) has a good untreated yield with relatively good Rhynchosporium resistance and a good specific weight. **Organa** (Senova) also has a high untreated yield but has shown moderate levels of brackling. Both LG Carpenter and Organa offer BYDV tolerance and are the first two-row varieties to do this, opening up opportunities for growers who prefer to grow a two-row variety but want to minimise risk and inputs.

Integral (Agrii) is a conventional six-row variety with high treated and untreated yield that has shown some susceptibility to mildew. It does, however, combine these high yields with BYDV tolerance. **Sixy** (Elsoms Ackermann) is another conventional six-row variety offering BYDV tolerance. It has a high treated yield, but its untreated yield is disappointing as is its specific weight.

Last, but certainly not least we have three six-row hybrid varieties. **Inys** (KWS) is the first hybrid barley from KWS and offers very high yield both treated and untreated along with a moderate disease profile. **SY Quantock** (Syngenta) also offers very high yield, both treated and untreated, as well as relatively good resistance to Rhynchosporium. **SY Kestrel** (Syngenta) has a lower treated yield, but a good untreated yield backed up by relatively good Rhynchosporium resistance. It also has the benefit of BYDV resistance, which all combine to make a lower risk variety. Finally, there is **Rosemary** (Elsoms Ackermann) which is still waiting to complete Variety Listing.

Again, a vast choice of candidates, many with similar data points, but it is very positive to see new resistance traits becoming more widely available which can only be a help to growers.

There are ten spring barley candidates, all with malting potential, but only five with data available at this point in time. **Ptarmigan** (Agrii) has high treated and untreated yields and good Rhynchosporium resistance, as does **KWS Enduris** (KWS). **LG Crossbow** (Limagrain) and **SY Arrow** (Syngenta) also have the benefit of high treated yield and good resistance to Rhynchosporium. **NOS Tucana** (Senova) currently sits just behind these on treated yield.

The five varieties waiting for Variety Listing are **Firecracker** (Agrii), **Thunder** (Agrii), **Admire** (Elsoms Ackermann), **LG Interceptor** (Limagrain) and **Nolan** (Senova).

Finally, there is **Sailor** (ADM) which is a Described candidate due to its Null Lox properties. Null Lox varieties have specific value for the end user and may well attract contract terms that offset its moderate yield levels.

Oats

Oats have slightly less activity, with one winter and one spring candidate. **Valentine** (Senova) is the winter candidate offering a high yield, relatively good mildew resistance and a moderate specific weight. **Caledon** (Saaten Union) is the spring candidate and offers very high yields treated and untreated. It combines these very high yields with good mildew resistance and promising grain quality, one to watch as further data is gathered.

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John Morgan, MGA

Maize soil nitrogen supply

NIAB and the Maize Growers' Association (MGA) undertook the first phase of a project investigating soil nitrogen (N) release in relation to levels of soil organic matter at three maize sites in 2023. The *Nitrogen through the growing season* project focused on improving understanding of Soil Nitrogen Supply (SNS) and Nitrogen Use Efficiency (NUE) in UK maize crops in order to assess the quantity and timing of nitrogen released from different soils and different growing conditions.

This MGA/NIAB initiative was supported by Wessex Water, Catchment Sensitive Farming (Natural England), Yara UK, KWS, Limagrain and Grainseed Ltd and is planned to continue at a larger scale in 2024. A combination of desk-top research, nitrogen response trials, overwinter nitrogen leaching recording trials, soil nitrogen testing (including Additional Available Nitrogen (AAN)) and consultation with farmers and industry identified a greater potential for soil to supply the N requirements of growing maize crops, particularly in higher organic matter soils.

Soil nitrogen release is influenced by soil type, moisture, temperature, organic matter and soil biology, with N availability increasing through June to August and maize N demand increasing during this same period. Increased understanding of the rate of soil N release during the maize growing season should allow better matching of applied N to crop need, improving Nitrogen Use Efficiency (NUE) reducing costs and associated environmental impacts.

Ellie Roberts is NIAB's forage crop specialist, managing the statutory and commercial forage crop trials programmes alongside providing technical and scientific knowledge on forage crops to NIAB members, APHA, seed companies, commercial businesses and educational organisations. She works with industry in developing research and training projects alongside contributing to NIAB's agronomy guides and publications.

Three work streams were undertaken during the 2023 growing season:

1. A literature review to improve understanding of soil nitrogen release during the maize growing season;
2. Soil nitrogen testing (including Additional Available Nitrogen) undertaken at three sites at regular intervals through the growing season;
3. Foliar (leaf) maize tissue analysis was undertaken to ascertain nitrogen content periodically throughout the growing season.

Nitrogen response curves were plotted for the Somerset and Norfolk sites as part of the wider MGA research programme. Data from the Somerset trial found no yield, maturity, or quality benefit from applying inorganic nitrogen, the SNS supply providing all the crop needed. This was found to be common in moist, warm, high organic matter soils. SNS in the Somerset trial was high (>300 kg/ha). The Norfolk site showed a yield and quality benefit of applying inorganic nitrogen post drilling, suggesting that the SNS alone was not sufficient to meet crop needs on the lower organic matter soil. SNS at the Norfolk site was the lowest of the three sites peaking at 130 kg N/ha.

In the UK, the period of rapid maize growth occurs when soils are warm and usually still moist. Soil N mineralisation is also influenced by temperature and moisture. It is important to note that as well as rate of mineralisation, N uptake also depends on soil moisture and

temperature, which heavily influences the amount and rate of microbial activity as well as plant physiology, soil organic matter, crop residues and tillage. Data on mycorrhizal root systems indicates these fungi have an important role in retaining nutrients in the soil organic matter (SOM), reducing leaching.

Efficient maize genotypes have been found to develop a greater root-to-shoot ratio and undergo a slower rate of phenological development, with a greater proportion of root biomass enhancing the N absorption capacity. Tillage system has also been found to influence nutrient uptake.

Tillage system, soil and weather factors should also be factored into N fertiliser recommendations, crop rotation and tillage alter SOM dynamics and C and N cycling with changes in soil organic carbon (SOC) and total N. Mineralisation of SOM can supply a significant proportion of N required by maize with amount of N supplied by SOM ranging from 60 to 130 kg N/ha depending on soil type, conditions and N stocks. Organic matter also impacts rooting and soil warming along with many other influential factors. Organic matter in maize soils can act as a temporary N sink, reducing leaching from fertilisation and releasing nitrates in following growing seasons.

Mineralisation

Gross N mineralisation measures the rate of inorganic ammonium production by soil organisms whereas net N mineralisation measures change in the size of soil inorganic N pools over time in the absence of roots. The supply rate of N from mineralisation of organic matter is limited by the rate of microbial mineralisation, which may then be subject to nitrification, immobilisation into the microbial biomass, and uptake by plants.

Undersowing and companion sowing maize with legumes, is increasing in order to improve NUE and provide soil cover after maize harvest. Incorporation of legume residues and animal manures have also been shown to increase net N mineralisation. Both gross ammonification and net N mineralisation rates are enhanced in high organic matter soils and management practices that increase labile organic matter, such as manuring, have been shown to enhance gross ammonification rates. Additionally, maize plant root activity has been found to enhance N mineralisation in the rhizosphere and thus the supply of N from organic N pools.

Inorganic N produced by gross ammonification of soil organic N has been found to be relatively high compared to maize uptake. Meeting maize N demand during periods of peak uptake with soil organic N therefore depends on the ability of the crop to compete with other ammonia consumption pathways which depends on the microbial immobilisation demand, nitrification and denitrification rates, as well as soil characteristics that determine the mobility of N (porosity, moisture, clay content), root morphology, physiology and N uptake efficiency.

Maize N uptake has been found to account for only a small proportion of the potential rate of soil N mineralisation. This suggests microbial production of ammonia could be sufficient to meet maize N demand in some soils during warmer months when taking into account small inorganic N pools with high turnover rates, as well as potential for maize to compete with microbes for mineralised N. Trial data from high SOM sites indicates that SNS from these soils can meet the N requirement of high yielding maize crops.

Conventional agricultural N management strategies assume roots compete poorly with soil microbes for inorganic N, only accessing N which is in excess of microbial demand so current N strategies largely rely on inorganic N fertiliser additions to achieve high levels of crop production and fail to account for SNS in maize ground to achieve synchrony between N demand and supply.

With high organic matter soils likely to meet maize N requirements through mineralisation of soil N during the period of rapid growth, the need for additional artificial N at that time is negated, contrary to current maize fertiliser N recommendations. This suggests that a review of the recommendations, taking soil organic matter into account is necessary with potential for both financial and environmental benefits.

By continuing to investigate the inorganic N supply capacity of the soil in 2024, we hope to help address the current asynchrony between maize N supply and demand in higher OM soils.

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Rust disease review of the 2022/23 season

The UK Cereal Pathogen Virulence Survey (UKCPVS) monitors the populations of the important cereal pathogens *Puccinia striiformis* f. sp. *tritici*, causing wheat yellow rust and *Puccinia triticina* causing wheat brown rust. Funded by AHDB and APHA, and managed by NIAB, the Survey has been running since 1967. It provides an early warning system to growers and plant breeders of new races of disease that could overcome current variety resistance, and underpins the AHDB Recommended List disease resistance ratings.

Wheat yellow rust

The wet weather in winter 2022 and spring 2023 was not conducive for rust development and the onset of yellow rust was late. As such, there was a dramatic drop in the number of yellow rust samples UKCPVS received in 2023, with just 92 samples across the season, far lower than previous years. The first sample arrived at NIAB on 3 February, with the majority of samples coming in during May (32) and June (45). The last sample arrived on 15 July. Yellow rust samples were received from 21 counties, covering a wide geographical area. Most samples, unsurprisingly, were received from the East; Lincolnshire and Cambridgeshire. But samples also came from Scotland, Northern Ireland, the South-West, the South-East and Northern England. Samples covered 37 different wheat varieties; the most prominent was KWS Extase (AHDB Recommended List [RL] rating 8), closely followed by Skyfall (RL rating 3).

In the 2023 adult plant trials, the full RL variety and RL candidate panel were inoculated with five 2022 isolates with the most complex or novel virulence profiles, the varieties generally performed as expected. Results showed 14 RL varieties were resistant to all five isolates (see UKCPVS Annual Report 2023 available on niab.com, ahdb.org.uk or scan the QR code).

In 2023, UKCPVS implemented several improvements to the Survey to deliver faster results on the resistance/susceptibility status of UK wheat to yellow rust and brown rust. Due to the lower number of samples received and a reduced number of differential wheat lines, the team were able to screen 36 isolates on a subset of the RL varieties and release the data several months earlier than usual (see UKCPVS review of the 2022-23 season on ahdb.org.uk or scan the QR code). This enhanced screen further highlighted the diversity within the UK wheat yellow rust population.

UKCPVS is implementing further changes in the 2024 Survey and will test in-season between 10 and 25 yellow rust isolates on the full panel of RL varieties

Early season yellow rust

Dr Charlotte Nellist is a programme leader in pathology with interests in disease resistance characterisation on a wide range of crops and understanding how pathogens interact with hosts.

Amelia Hubbard joined NIAB in 1999 and works within the plant pathology group, based in Cambridge. She manages and delivers the technical work for UKCPVS with a focus on yellow rust and brown rust. She also supports and contributes to the delivery of the Recommended List and Variety List cereal disease trials and other UK and EU pathology projects.

NIAB's Head of Pathology Dr Kostya Kanyuka leads programmes on the biology, control, and detection of diseases of wheat and other arable crops. He is a molecular plant pathologist with more than 15 years of experience in leading research on genetics and mechanisms of disease resistance to fungal and viral diseases in cereal crops including Septoria and rusts, and development of genomic tools for better understanding of plant-pathogen interactions.

and candidates, releasing data in-season, over the summer. The Survey will also implement more targeted sampling, particularly from under-sampled regions, to ensure a better representation across the UK. The team will release heat maps detailing the counties where samples have been received from. If your county is not represented, please send a sample in with details at the end of the article.

Using seedling tests, we determined the virulence profile for a selection of 36 isolates in 2023. Virulence for *Yr1*, *2*, *3*, *4*, *6*, *7*, *9*, *17* and *32* all remained very high in the population. Virulence for *Yr8* is the one to always keep a close eye on; it has been at low levels in recent years and was detected in one isolate characterised in 2023. No virulence was detected for *Yr5*, *Yr10*, *Yr15* or *Yr24*. We also include key additional varieties in our tests. Noteworthy ones include virulence on KWS Extase; detected in 22% of isolates. Virulence for Crusoe was also detected in 22% of isolates.

The two most common pathotypes (combination of virulence genes) identified in the characterised isolates were *Yr1*, *2*, *3*, *4*, *6*, *7*, *9*, *17*, *32*, *Sp* and *Wa* (14% of isolates) and *Yr1*, *2*, *3*, *4*, *6*, *7*, *9*, *17*, *32*, *Re*, *Sp*, *Wa*, *St*, *Kr*, *Ap* and *Cr* (14% of isolates). Four new pathotypes were also identified.

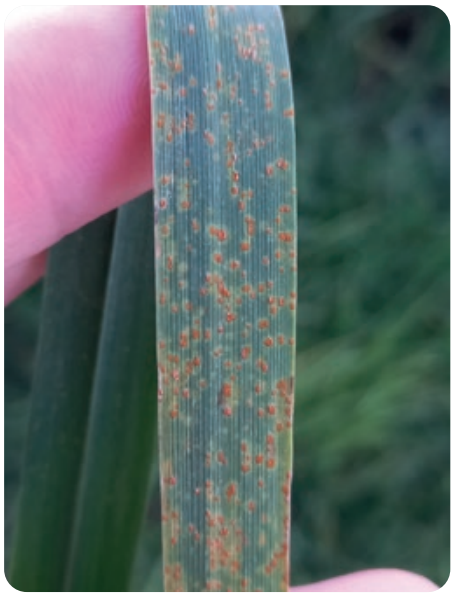
UKCPVS has deployed routine genotyping of wheat yellow rust isolates, based on Dr Diane Saunders' (John Innes Centre) MARPLE pipeline (Mobile And Real time PLant disEase diagnostics) for the past five years. Genotyping is categorising individual yellow rust isolates, based on their collection of genes. Sampled isolates may be checked against genetic groups known to be rare or absent in the UK yellow rust population. The Red Group, previously known as Warrior 4 or Warrior (-), has been predominant in the UK for the past five years. Of the 23 isolates genotyped in 2023, 21 belonged to the Red Group. The Red Group remains very diverse, with a broad range of virulence profiles present, as mentioned above. Over the past five years, genotyping has helped identify unusual isolates from the Pink Group (Warrior) (one isolate belonged to this group in 2023) and the Purple Group (Kranich) (one isolate belonged to this group in 2023). Over the five years, the pattern of isolates from the different genetic groups has remained fairly static, with the majority of isolates belonging to the Red Group, with occasional Pink Group and Purple Group isolates popping up.

Looking ahead to the 2024 season, at the time of writing, two samples of yellow rust have been received by the UKCPVS team; one from Cambridgeshire and one from Leicestershire. The recent wet weather will have hampered yellow rust growth, but growers are advised to monitor all varieties carefully this season and to report unusual levels of disease to UKCPVS as soon as possible.

Wheat brown rust

As with yellow rust, the number of samples of brown rust received into the Survey in 2023 were also low, with just 15 from across England. In 2022, there were reports of an unusual sighting of 30% brown rust infection on Theodore (RL 2023/24 brown rust rating 8) in Devon. In 2023, samples from Theodore came in from Devon, Dorset and East Yorkshire, indicating isolates with virulence (ability to cause disease) on the variety was spreading. The survey postulates that Theodore carries the resistance gene *Lr24*. In 2019-2021, no isolates were detected possessing virulence to *Lr24*. In 2022, this rose to 12% and jumped further up to 40% in 2023. An isolate possessing virulence to *Lr24* has been included in the variety List and RL inoculum to ensure future candidates and varieties are exposed to this virulence and tested against it.

In seedling tests, candidate variety RGT Goldfinch performed well and was resistant to all five isolates tested on the full panel of RL varieties and candidates at the seedling stage. All other varieties were susceptible to at least one isolate.



Wheat brown rust

UKCPVS Annual Report 2023

UKCPVS wheat yellow rust and brown rust: review of the 2022/23 season

We need your help

UKCPVS relies on samples of interest sent in by growers, agronomists, and breeders amongst others. This year the survey is focusing on wheat yellow and brown rust and we welcome samples from all RL and RL candidate varieties from across the country. It is really important to receive representative samples from around the country to get an accurate picture of what is happening in the rust populations. Full sampling details are available on niab.com – type UKCPVS in the search box or click on the QR code below.

Summer Events 2024

FIND US AT KEY INDUSTRY EVENTS

Cereals THE ARABLE EVENT

Tuesday 11 & Wednesday 12 June
BALDOCK, HERTFORDSHIRE

Groundswell

Wednesday 26 & Thursday 27 June
HITCHIN, HERTFORDSHIRE

FREE AND OPEN-TO-ALL
BOOK YOUR PLACE AT NIAB OPEN DAYS

Featuring variety and agronomy demo plots, advice and research

BLACK-GRASS • Monday 3 June
GRASS WEED MANAGEMENT – HINXTON, CAMBRIDGE

STAR • Tuesday 4 June
SOILS AND ROTATIONS – SUFFOLK

DIVERSE WEEDS • Tuesday 4 June
BROAD-LEAVED WEED MANAGEMENT – HINXTON, CAMBRIDGE

SOUTH • Tuesday 18 June
VARIETIES AND AGRONOMY – SUTTON SCOTNEY, HAMPSHIRE

EAST • Thursday 20 June
VARIETIES AND AGRONOMY – MORLEY, NORFOLK

NORTH • Tuesday 2 July
VARIETIES AND AGRONOMY – CROFT, CO DURHAM

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

NIAB Agronomy members have exclusive access to additional local cereal variety and agronomy days at our Cirencester, Warwick, Taunton and Kingsbridge trials sites, plus specialist events at Woodhall Spa (weeds).

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

NIAB
world-class experience, skills and resources

Ros Lloyd • ros.lloyd@niab.com

Putting our plant science into practice this summer

With over 25 years of experience in farming and scientific communications Ros Lloyd is NIAB's Head of Communications. She manages and produces the organisation's PR and communications, conveying to many different audiences all aspects of work carried out by NIAB, through various channels including events, online, social media, publications and press to meet member and stakeholder needs.

The Cereals Event. NIAB Black-grass Open Day. Morley Innovation Day. NIAB South Open Day. The summer events programme, of which these are just a few, is a key point in the calendar for NIAB, its customers, clients and stakeholders – have you booked your places via niab.com?

The events are our annual opportunity to share the breadth and depth of our research work and expertise with growers and agronomists; demonstrating how they can and will be put into practice on farm and the economic and agronomic benefits in their use. From the variety advice that NIAB is renowned for to the latest disease, weed and pest management options, via crop nutrition, soil management and a look at alternative crops.

But as Mario highlights in his opening article in this issue of *Landmark*, these trade and in-house events are also an opportunity to showcase the translation of "fundamental scientific discoveries into practical farming innovations which can boost productivity while addressing climate and biodiversity challenges."

With over 20 different crop species in plots, at time of writing dependent on spring drilling success and if the rain ever stops, the NIAB stand at the 2024 Cereals Event on 11 and 12 June, this year near Baldock in north Hertfordshire, is a great example of this 'plant science into practice'.

Plots will showcase research into the genetic control of yield, yield components, disease resistance and quality traits in cereal crops, with particular focus on wheat, including contrasting lines that construct yield in different ways, for example grain size, ear size and tiller number. The theme is Septoria on our pathology plots, demonstrating NIAB re-synthesised wheat lines that showed an excellent resistance against the disease in 2023.

In our legumes area, plots of peas and beans, lentils and lupins, chickpea and soya all help visitors to uncover the benefits of protein crops by exploring the opportunities for crop diversification and lowering inputs on farm and new market prospects as a plant-derived protein source in food and animal feed. As part of the display NIAB's research into improving UK food legumes is showcased, from work on sequencing peas and beans for nutritional quality and the presence of anti-nutritional compounds, to field trials testing how genotype/environment interactions influence crop quality. It also includes the development of genetic resources in faba beans, exploiting natural diversity to improve disease resistance against major diseases, including chocolate spot, downy mildew and Fusarium foot-rot.

The NIAB-led, multi-partner Centre for High Carbon Capture Cropping (CHCx3) project aims to help UK farmers and growers target Net Zero and build farming resilience through diversifying their arable and forage cropping. Visitors can take a look at a wide range of the

UK's underutilised and novel crops that may become more popular over the next few years on farm, and discuss crop management options with NIAB specialists and advisors. With six herbal grazing ley mixtures alongside flax, miscanthus, buckwheat, quinoa, durum wheat, and triticale growers have the option to view some of these crops above and below ground in the 20 metre long NIAB Soil Hole.

This CHCx3 work is also available to discuss on NIAB's stand at the Groundswell Event on 26 and 27 June, just down the road from the Cereals Event, where we feature our research, advice and information within the principles of regenerative agriculture. NIAB is also the sponsor of the event's Soil Seminar Marquee, with NIAB speakers covering the science behind regenerative agriculture.

NIAB Open Days

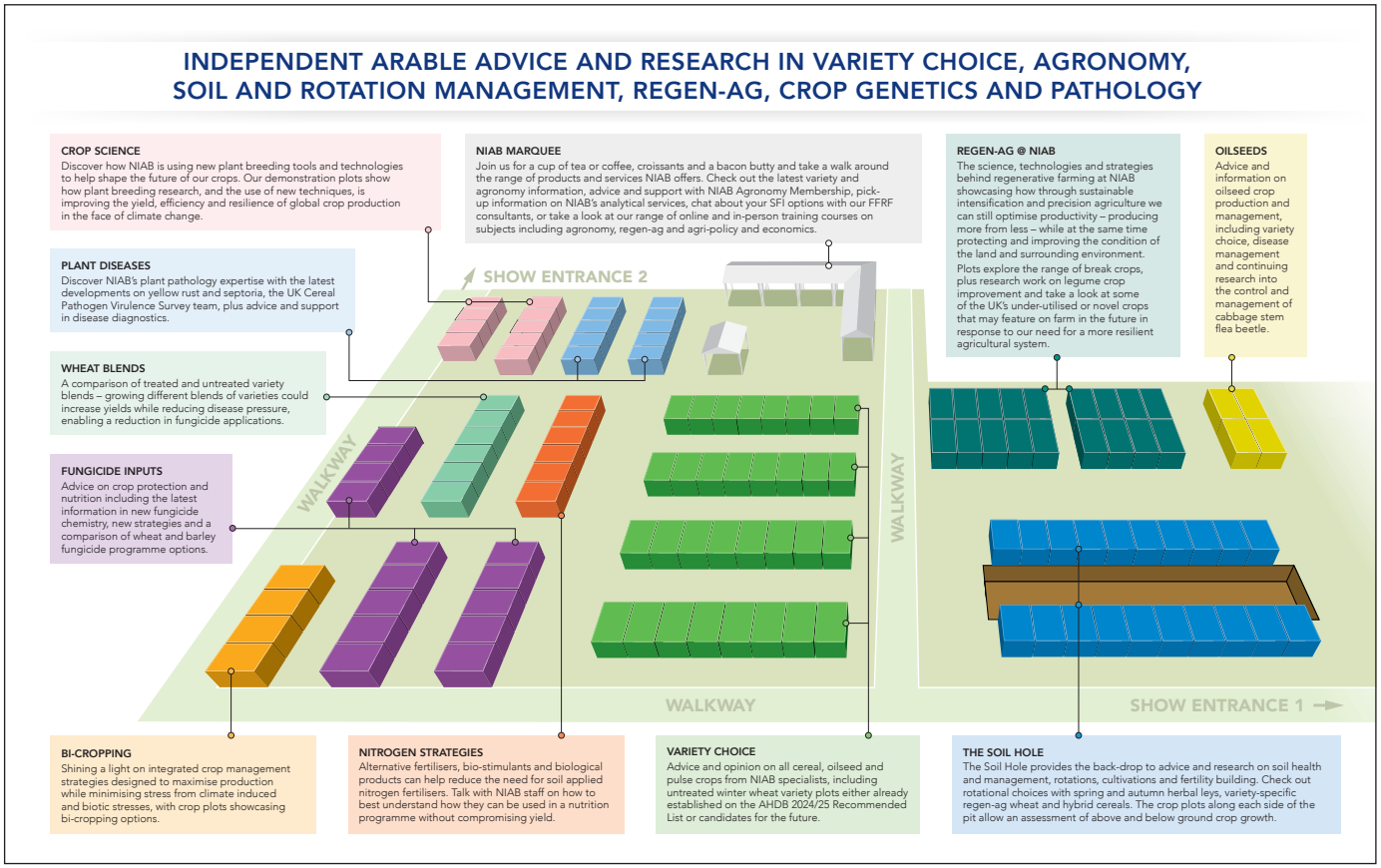
Our traditional and popular variety demonstration plot tours are still the main feature at many, if not all our in-house events, alongside agronomy advice and opinion from our team of crop specialists with a range of plots covering disease management, nitrogen strategies, soil and rotation management and weed control.

Two specialist events kick off proceedings with a new location for our Black-grass Open Day, the first open event covering the grassweed since before the pandemic. Both this open day on 3 June and our Diverse Weeds Event, a demonstration of sustainable management of broad-leaved weeds, on 4 June will take place at our Cambridge-Hinxton trials site. Of the regional NIAB Open Days, our southern event is back at Sutton Scotney, in Hampshire, on 18June with a range of practical variety and agronomy demonstrations. Our Cambridge Open Day is a 'no-show' this year due to the nearby Cereals Event, but will be back in 2025 when Cereals returns to Nottinghamshire.

We are also running NIAB plot tours as part of the Morley Innovation Day in Norfolk, hosted by The Morley Agricultural Foundation on 20 June, this year in partnership with the AHDB Strategic Cereals Farm (East) Open Day, and at the Croft Open Day in Co Durham, hosted by Croft Farms alongside event partner ArGrain, this year a little later on 2 July. Both events combine field demonstrations with exhibits with research partners, funders and industry, ensuring the latest independent information and advice from a wide range of specialists.

Book your place at our events by logging onto www.niab.com and click on the NIAB Events Hub

The NIAB stand at the 2024 Cereals Event



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Anusree Saha • anusree.saha@niab.com

Of tillering and parasitic weeds – wheat N response

In a BBSRC funded project, NIAB is investigating the role of strigolactones in regulating the numbers of tillers in wheat in response to increased nitrogen availability. What are strigolactones? Why do we think they may be useful to develop wheat varieties with low nitrogen requirement?

Grain yield is achieved by enabling the production of a high number of grains, that are each of high weight. The grain number component of yield is controlled by the number of productive tillers and the number of grains per ear/spike. Tillers are essentially branches for a wheat plant and at the biological level, we understand quite well how branching is regulated. Many would be familiar with the phenomenon of apical dominance.

As a gardener, if one wants to induce the growth of side branches, cutting the top (the apex) of the plant will enable these axillary branches to grow further. It has been known for 100 years or so that the phytohormones auxins produced at the apex travel rootward and prevent the development of axillary buds. For many years, scientists had an hypothesis that a signal from the roots could also prevent the growth of side branches. It was quite surprising for many to find out that these signal molecules were already known. These compounds are called strigolactones and they are also released in the soil as root exudates. They were already well known

Dr Stéphanie Swarbreck is NIAB's group leader for crop molecular physiology, studying how plants integrate and respond to different environmental conditions such as nutrient availability and the presence of neighbours, for example black-grass.

Dr Anusree Saha is a postdoctoral researcher at NIAB. She is studying the role of Strigolactone in the regulation of wheat nitrogen responsiveness, therefore leading to selecting and developing wheat varieties with lower nitrogen requirement.

for their role in inducing the germination of parasitic weeds such as witchweed or *Striga lutea*. The witchweed relied on these signal molecules as a cue to trigger germination and guide to the roots of the host plants.

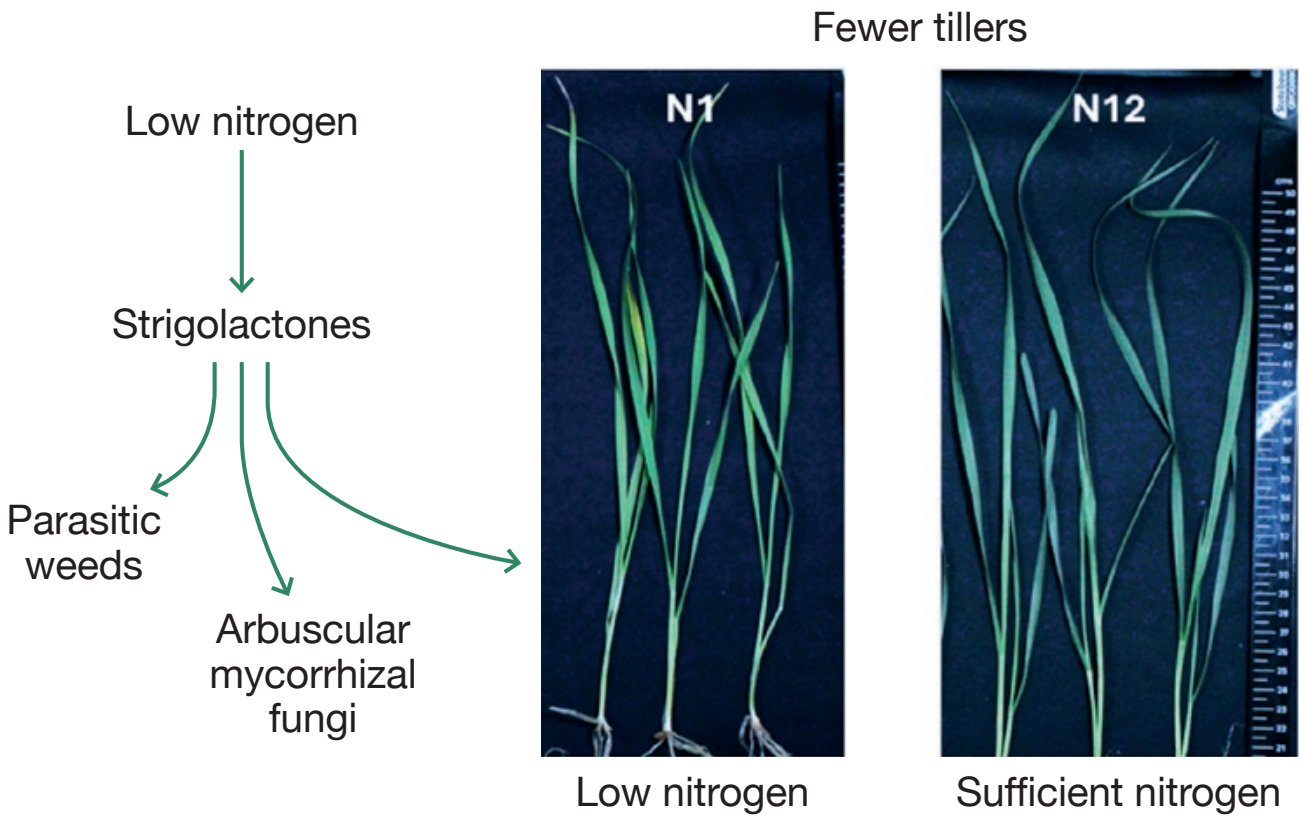
Strigolactones are part of a family of compounds that are produced in the roots and can move in the plants towards the shoots. They are classified as a new class of plant hormone because of their diverse functions in regulating above-ground plant structure (such as inhibiting bud outgrowth) and in underground communication with neighbouring organisms. Besides their role in inducing parasitic weed germination, they can also induce the growth of arbuscular mycorrhizal hyphae, particularly in nutrient deficient environments. Consistent with their role in branching regulation, mutant plants that cannot produce strigolactones have many branches. Similarly, mutant plants that cannot perceive strigolactones as a signal, also have many branches. Many of the genes involved in the synthesis and the perception of strigolactones have been characterised in model species such as *Arabidopsis thaliana* or in crop such as rice, but little is known of the pathway in wheat.

NIAB is working with some of these mutant lines which have defects in perceiving strigolactones. Since the mutant plants fail to produce functional strigolactones receptors and proteins in the perception pathway, we have noticed increased branching in the plants even in low nitrogen conditions. We are also generating wheat lines that carry non-functional form of genes that are involved in strigolactones perception pathway.

One of the ways that the striga parasitic weed problem is fought in Africa is through the co-cultivation of maize and desmodium, a nitrogen-fixing legume. Desmodium can produce allelopathic compounds in the soil that interfere with the striga parasitism and it also provides added nitrogen to the maize. This point is very important because strigolactones are produced under low nutrient availability especially nitrogen and phosphorus, hence the link to arbuscular fungi; it is a signal emitted from the plant that enable the establishment of symbiosis to provide more nutrients. Given that the number of tillers is highly regulated by the level of nitrogen in the soil, lower N level leading to fewer tillers, we are interested in understanding whether strigolactones do play a role in controlling the number of tillers in response to the level of available nitrogen.

Further analyses of the mutant lines mentioned will enable us to investigate how certain components of the strigolactones perception pathway can regulate plant nitrogen response and establish the mode of regulation of strigolactones-mediated N responsiveness. This fits in our broader efforts in improving wheat N responsiveness, which is defined as the plant capacity to undergo morphological and physiological changes according to external N availability, resulting in changes in N uptake and assimilation. N responsiveness has been demonstrated to be the highest under low N conditions and subsequently decreased when N availability increases.

In summary, NIAB is trying to find solutions to select crop varieties that require low N input which is critical for sustainable crop production system. By implementing the recent advances in wheat genomics such as genome sequencing and availability of mutant lines, we aim at understanding the underlying mechanism of N responsiveness in wheat and involvement of Strigolactones in the entire context. This information will enable breeders to select wheat lines that are high yielding, of high grain quality and suitable for lower N input.



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Sustainable Farming Incentive – how should you view it?

In 2024, we are in the first year of decoupled Basic Payments Scheme (BPS) with only three further years (until end of 2027) left for any BPS in England. Agricultural Transition is now at the 'biting hard' stage, with remaining BPS now worth less than 50% of what they were.

Just in the nick of time, Defra have launched the Sustainable Farming Incentive (SFI). Intended to be an easy to apply for, lowish commitment level, non-competitive scheme that helps replace lost BPS payments and ticks boxes for the principle of 'public money for public good'.

This scheme sits alongside several other incentive and grant schemes ranging from capital grant schemes to help farms invest in better equipment (aimed at reducing energy use, increasing labour efficiency, and reducing environmental impacts), land management for nature schemes and support for woodland creation and management.

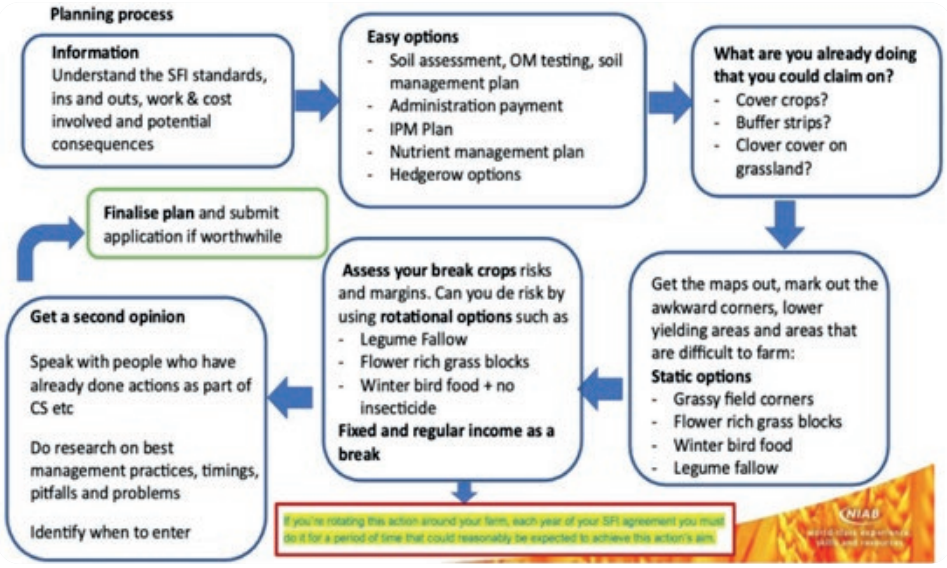
At the time of writing, Defra have recently announced the milestone that more than 10,000 farms have applied for the SFI scheme. The current scheme is often referred to as SFI 2023. More options for the future have already been announced, with SFI 2024 set to start to become available both to current and future scheme members from June.

Farmer opinions of the scheme seem to vary quite widely, with some saying, "not enough in it to be worth it", through "seems ok", to "we're getting more money now than we ever did from BPS".

You could be forgiven for wondering if this is related to how closely farm businesses have studied the scheme. Whilst no scheme will probably ever either appeal to or be the right thing for every business, Defra are trying to make its appeal as wide as possible. Some may say for both farmers and consultants!

For a long time, financial surveys have shown many 'averagely performing' farm businesses struggle to break even until BPS payments are added in. Does this mean that farms will have to join SFI to survive? The short answer to this is 'no'. However, for businesses that are either unable or unwilling to earn income from non-farming sources or earn premium returns from food production enterprises; having some form of public-funding support does seem necessary – for now at least.

Figure 1. What to consider when planning an SFI application



Phil Humphrey has worked as a field agronomist and farm adviser, working mostly with combinable crops, maize and grassland. He now supports NIAB Agronomy and Farming Systems teams, with input into a range of projects, including FFRF.

Will Vaughan-France is NIAB's regional agronomist covering the south west and is also the membership services development lead. He is based in Somerset with his own farm and has experience in a range of technical and commercial organisations.

Greg Crawford studied agricultural business management at Newcastle University. He went on to work for various agri-businesses working across arable, beef and horticulture before joining NIAB in 2022 as the farm business resilience consultant. Greg's role is visiting participants of FFRF to complete the farm business review and report that forms the initial stage of the FFRF support, before signposting to specialist technical advice.

Applying for SFI

So, what does SFI entail and should farms not already involved dive in as

soon as possible or wait a bit longer? For a start, despite the name, it is not a route to sustainable farming, but more an encouragement to find a bit more space for nature – just as the original Entry Level Scheme (ELS) did. Bearing this in mind, it is no surprise to find that many of the current options are the same as or very similar to management options in ELS.

Despite the initial similarities to ELS, a key difference is that the way land needs to be managed is far less prescriptive. So instead of having to mow at set times etc; the emphasis is on achieving 'the aims' of each specific option, leaving the farmer with more flexibility as to how this is done. Payments are also quarterly, which is good for cashflow.

Agreements are for three years (Figure 1). Applications can be made at any time of the year and can be expected to start on the 1st day of the month following acceptance and processing of your application. As some options remain on the same land for three years, whilst others can be rotated annually, it is worth considering how a particular start date will affect the start and end times of options, particularly rotational ones, which will need to be compatible with following crop establishment periods in either the autumn or spring.

Studying the 23 options currently available, it is useful to categorise them. Defra has done this to an extent. Another useful way of looking at them is shown in Figure 2, where options can be divided into three broad categories:

- things that can be done on arable or horticultural land;
- things that can be done on grassland;
- things that can be done on moorland.

Then within these three categories:

- things that can be done whilst growing a crop;
- things that can be done instead of growing a crop;
- things that can be done to demonstrate good land management.

Full details of SFI 2023 can be found in the *SFI 2023 Handbook* on the www.gov.uk website. Within this, there is a useful summary of the options including the eligible land types and payments (Figure 3). Please note that payment rates for some options have been increased since the handbook was published.

For any land management scheme, some options will incur more input costs than others, so this should be considered alongside the payment rates. Income forgone and costs saved if SFI options replace agricultural production should also be calculated. Therefore, consider operating costs attached to both growing a crop and managing the SFI option that replaces it. For combinable crops, operation costs are often £350-450/ha. In many cases, especially where crop yields have been sub-optimal, there may not be much financial difference. Then remember that so long as the aims of an SFI option are met, the income is less volatile than potential income from growing a crop.

Here are some examples of how options can be fitted into a farm business:

1. If you manage hedgerows – get paid for what you already do.

Three options available:

- Hedgerow condition assessment – £5-10/100 metre length.
- Hedgerow management (cutting regimes) – £13-26/100 metre length (unless already doing as part of a Countryside Stewardship agreement).
- Hedgerow tree maintenance – £10 per 100 metre length. Provided there's an average count of at least one tree per 100 metre length and you have management control of both sides of the hedge.

Figure 2. SFI 2023 option types

Land type/option type	Arable (inc. temporary grassland and horticulture for some options)	Permanent grassland	Moorland (inc. SDA land for some options)
Within a crop	Companion crops No insecticides	Winter wild bird food Legumes Herbal Leys Very low input managed grassland	Very low input managed grassland
Instead of a crop	Multi-species over winter cover, Herbal leys, Flower rich areas, Legume fallow, Pollen and Nectar mixes, Winter wild bird food, Grassy buffer strips and field corners	Grassy buffer strips and field corners	
Land Management	SFI management payment Soil, Nutrient and IPM plans Hedgerows (3 options)	SFI management payment Soil, Nutrient and IPM plans Hedgerows (3 options)	Moorland plan Additional common land payment

Figure 3. Summary of SFI 2023 Options (please note that payment rates for some options have been increased). Source: SFI Handbook for the SFI 2023 offer (www.gov.uk)

Code	SFI action	Rotational or static action	Total or part SFI available area in each land parcel	Annual payment	Arable land		Permanent crops		Permanent grassland		Moorland	Hedgerows
					Arable crops	Temporary grassland	Horticultural	Non-horticultural	Improved	Low input		
Actions for soils												
SAM1	Assess soil, test soil organic matter and produce a plan	Static	Total only	£6.00 per ha and additional payment of £97 per agreement	✓	✓	✓	✓	✓	✓		
SAM2	Multi-species winter cover crops	Rotational or static	Total or part	£129 per ha	✓	✓	✓					
SAM3	Herbal leys	Rotational or static	Total or part	£382 per ha	✓	✓			✓			
Actions for moorland												
MOR1	Assess moorland and produce a written record	Static	Total only	£10.60 per ha and additional payment of £272 per agreement							✓	
Actions for hedgerows												
HRW1	Assess and record hedgerow condition	Static	Not applicable	£5 per 100m – one side	Not applicable – linear SFI action which can be done on the boundaries of these land types							✓
HRW2	Manage hedgerows	Static	Not applicable	£13 per 100m – one side	Not applicable – linear SFI action which can be done on the boundaries of these land types							✓
HRW3	Maintain or establish hedgerow trees	Static	Not applicable	£10 per 100m – both sides	Not applicable – linear SFI action which can be done on the boundaries of these land types							✓
Actions for integrated pest management												
IPM1	Assess integrated pest management and produce a plan	Not applicable	Not applicable – agreement level SFI action	£1,129 per year	✓	✓	✓	✓	✓	✓		
IPM2	Flower-rich grass margins, blocks, or in-field strips	Rotational or static	Total or part	£798 per ha	✓	✓	✓	✓				
IPM3	Companion crop on arable and horticultural land	Rotational or static	Total or part	£55 per ha	✓	✓	✓					
IPM4	No use of insecticide on arable crops and permanent crops	Rotational or static	Total only	£45 per ha	✓		✓	✓				
Actions for nutrient management												
NUM1	Assess nutrient management and produce a review report	Not applicable	Not applicable – agreement level SFI action	£652 per year	✓	✓	✓	✓	✓	✓		
NUM2	Legumes on improved grassland	Rotational or static	Total or part	£102 per ha		✓			✓			
NUM3	Legume fallow	Rotational or static	Total or part	£593 per ha	✓	✓	✓					
Actions for farmland wildlife on arable and horticultural land												
AHL1	Pollen and nectar flower mix	Rotational or static	Total or part	£739 per ha	✓	✓	✓					
AHL2	Winter bird food on arable and horticultural land	Rotational or static	Total or part	£853 per ha	✓	✓	✓					
AHL3	Grassy field corners and blocks	Static	Total or part	£590 per ha	✓	✓	✓					
Actions for farmland wildlife on improved grassland												
IGL1	Take grassland field corners or blocks out of management	Static	Total or part	£333 per ha		✓			✓			
IGL2	Winter bird food on improved grassland	Rotational or static	Total or part	£515 per ha		✓			✓			
Actions for buffer strips												
AHL4	4m to 12m grass buffer strip on arable and horticultural land	Static	Total or part	£515 per ha	✓		✓					
IGL3	4m to 12m grass buffer strip on improved grassland	Static	Total or part	£235 per ha		✓			✓			
Actions for low input grassland												
LIG1	Manage grassland with very low nutrient inputs (outside SDAs)	Static	Only total SFI available area, unless done with IGL1	£151 per ha		✓ outside SDAs			✓	✓		
LIG2	Manage grassland with very low nutrient inputs (SDAs)	Static	Only total SFI available area, unless done with IGL1	£151 per ha		✓ SDAs below moorland line			✓ SDAs below moorland line	✓ SDAs below moorland line		

2. Straighten up awkward arable field corners – take a no-risk payment and carry on farming the better bits. £590/ha – with very little input costs.
3. Stop managing grassland early to allow seed heads to be present over winter for wild bird food. £515/ha – with very little/no input cost.
4. Take a small payment for a small amount of input and bolster cropping margins. £129/ha for an overwinter cover that protects the soil containing at least one species from two different plant families. This can be a mix purely grown for cover, followed by say spring barley, with £45/ha additional payment for not using an insecticide, which then may also mean the crop could perhaps attract a further premium for a market that rewards the crop being grown with environmental impact in mind (e.g. conservation grade). A further £55/ha can be earnt if the spring sown crop also has a companion crop sown with it. It could also be an early sown winter crop with at least one companion species. For example, an early sown winter cereal with beans or oilseed rape as a companion, which may or may not be taken to harvest (Figure 4).

On 25 March, following concerns that too much land could be taken out of food production, the Government announced an intention to cap certain 'non-crop' options to 25% of an applicant's land area. This includes options mentioned at points 2 and 3 above.

SFI 2024

Some information is now available for additional options that are planned to become available from summer 2024 (SFI 2024). There will be an application process that allows both existing scheme members and new applicants to take up these options. Current details can be found on www.gov.uk 'Technical annex: The combined environmental land management offer'. The promotional headline for this scheme is '50 new options'. There are also many options being brought in from existing Countryside Stewardship schemes. Some of the new options are quite similar to existing ones but extend the range of choice.

Other new options include:

- the use of direct drills and precision cultivation or application machinery;
- managing peats;
- enhanced woodland management;
- provision and maintenance of public access;
- and land use for natural flood management.

For arable farmers, some of these options allow farmers to be paid per hectare for using equipment that may already be in use or been purchased through one of the rounds of the Farm Equipment and Technology Fund (FETF) or Improving Farm Productivity Fund (IFPF) capital grant schemes. For example, £73/ha for establishing crops by direct drilling, £27/ha for use of variable rate fertiliser applicators, or up to £150/ha for robotic weed control.

Figure 4. Early sown winter wheat with beans

Future Farming Resilience Fund

Via the Future Farming Resilience Fund (FFRF), a Defra scheme designed to ensure all farmers get access to free farm business advice, NIAB can provide on-farm visits to farms that are eligible for BPS.

The visits can range from conducting a full SFI planning service to develop a plan that complements your business and farming system; through to doing a full business review (business health check), to help identify opportunities for improved business performance and resilience to change.

For more information or for a no obligation enquiry:

www.futurefarmingresilience.com

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SFI 2023 Handbook for the SFI 2023 offer

Technical annex: The combined environmental land management offer (Defra)

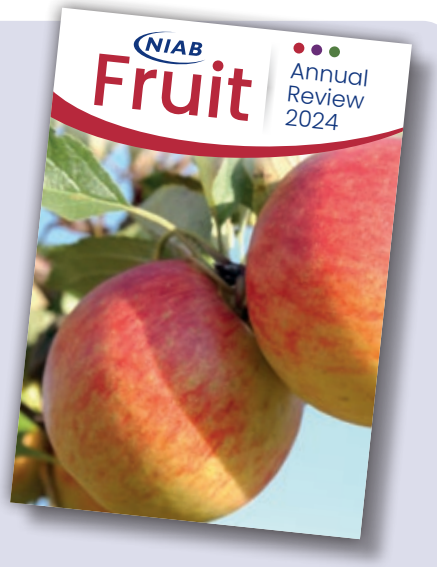
Tricia wins NIAB staff medal

With a career spanning an astonishing 53 years at NIAB, Tricia Cullimore has been awarded the 2024 Bentley Nelstrop Medal for Enterprise and Innovation, NIAB's annual staff award celebrating exceptional contribution to innovation and enterprise.

Tricia's contributions have been central to NIAB's ability to remain an integral part of the statutory and Recommended List trials systems for sugar beet, maize, pulse, herbage and a whole host of minor crops whose popularity has ebbed and flowed over the past 50+ years. Tricia's enterprise and innovation has allowed, at times, rapid development and implementation of effective systems in an everchanging statutory and levy-funded world. She has also been central to archiving and studying NIAB's history, with much of her research and information forming the backbone to NIAB's Centenary celebrations in 2019, resulting in her meeting HM Queen Elizabeth II on her visit to NIAB.

Tricia started at NIAB in 1971 and over the years her knowledge of trialling, farming and the agricultural trade as a whole has earnt her great respect with our customers and staff. Tricia retires later this summer and we wish her the very best for the future, and many congratulations.

NIAB Fruit 2024 Annual Review



After the success of the first NIAB Fruit Review in 2023, the 2024 issue was published in April. The publication provides a portfolio of the current fruit research work at NIAB, with summaries of recently commissioned projects and feature articles with results of ongoing projects. It also provides updates on the activities of The WET Centre, The Plum Demonstration Centre and the rapidly evolving Research Vineyard and Wine Innovation Centre.

The Review summarises progress in both the rubus breeding and apple rootstock breeding programmes, whilst offering an overview of our latest activities to support the development of recycled coir growing media. A significant section briefs readers of our many and varied activities within the Growing Kent & Medway programme, which support plant-based food and drink industries in the Kent & Medway region.

Horticultural Knowledge Exchange Manager and the Review's editor Scott Raffle explains: "The 2023 Review was very well received by the fruit industry, providing businesses with an overview of the breadth and depth of our research work and expertise at NIAB. The publication has a wide reach across the industry, helping us to raise the profile of what we do."

Copies of the NIAB Fruit 2024 Annual Review will be available to take away at this year's Fruit Focus event on 10 July, as well as being available at NIAB offices in East Malling and Cambridge. Download your digital copy at niab.com.

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Yellowhammer: yellow rust resistance in UK and Northern European winter wheat

NIAB has supported the UK wheat breeding industry for many years, helping to define the genetic diversity of target breeding traits and thereby supporting breeding efforts to produce improved wheat varieties for producers.

Between 2018 and 2023 NIAB led a collaborative project with seven breeding companies focused on understanding the genetic diversity underpinning resistance for the wheat disease yellow rust. This project, called Yellowhammer, was funded by BBSRC and AHDB.

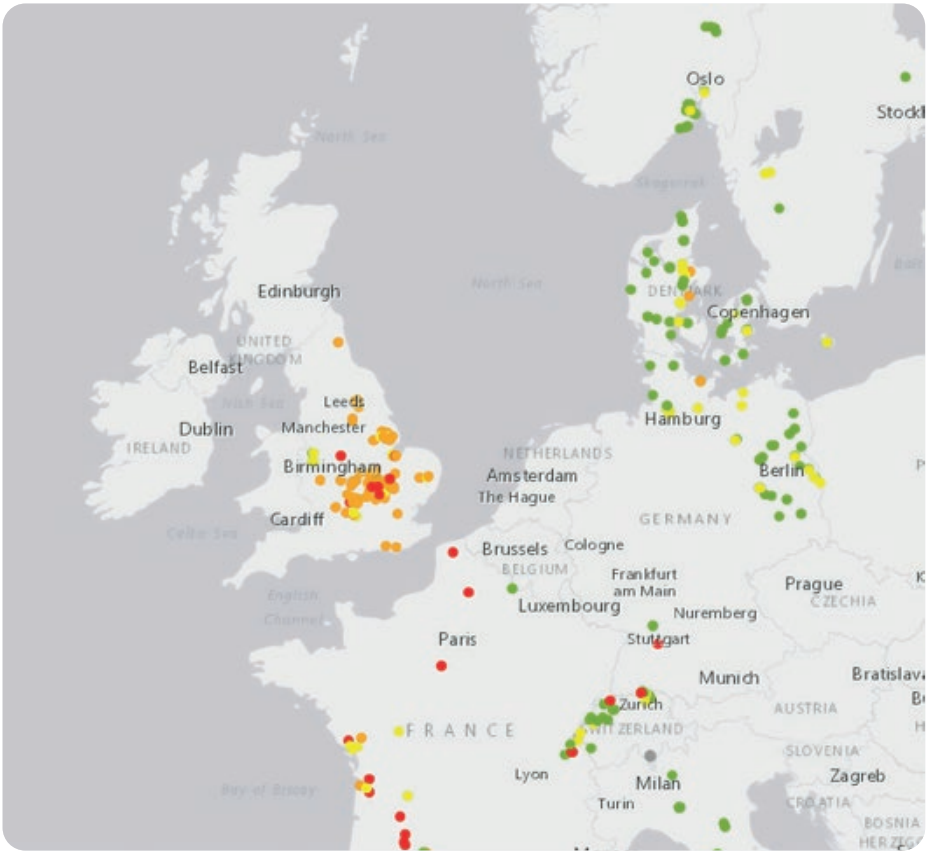
Yellow rust is a major threat to wheat production in temperate and maritime climates as found in the UK and northern Europe (Figure 1), infection significantly reducing yield. Yellow rust is caused by the biotrophic fungus *Puccinia striiformis* f. sp. *tritici (Pst)*, an airborne pathogen that produces multiple cycles of infection during the wheat growing season. Integrated pest management (IPM) approaches are applied to limit disease, consisting of a combination of farm management, agrochemical application, and the growth of disease resistant varieties. Disease prevention, via growth of resistant varieties, is a key component of this IPM scheme and represents an environmentally sustainable solution. Consequently, the effective deployment of existing and new sources of yellow rust resistance within wheat varieties is increasingly important.

The Yellowhammer project has identified multiple sources of yellow rust resistance. A panel of 427 winter wheat varieties, representing the genetic diversity within wheat varieties deployed across the UK and northern Europe over the past 60 years, was established in 2018. Between 2018 to 2022 this panel of wheat varieties was assessed for yellow rust resistance in a total of 14 locations across the UK and northern European, including the UK, France, Germany, Denmark and Sweden. Variation was seen in the levels of yellow rust infection between the wheat varieties across field trial locations and years, as shown for 2022 (Figure 2). This may reflect the different environments, some locations being more conducive to yellow rust infection, but may principally be due to

Dr Lesley Boyd has led a research programme focussed on understanding wheat/rust interactions since 1995, with a primary focus on those sources of rust resistance that have a non-race-specific phenotype. She is an internationally recognised expert on wheat-rust genetics and biology.

Dr Camila Zanella is a senior post-doctoral researcher in the plant pathology team at NIAB. Her research focuses on the application of classical genetics studies, plant molecular genetics and genomics to investigate the genetic control of disease resistance and yield components in wheat.

Figure 1. Occurrence of yellow rust on wheat across Europe in 2021. The map shows the locations within Europe where yellow rust occurred and the level of occurrence in 2021. Yellow, red and orange represent low, moderate and severe outbreaks, green represents absence of disease in 2024 (Source: Rustwatch 2024)



Source: https://agro.au.dk/forskning/projekter/rustwatch/news-and-events/show/artikel/yellow-rust-in-europe-2021

genetic differences in the *Pst* populations present at each location.

To locate the sources of yellow rust resistance on the wheat genome and to enable the breeders to develop DNA markers that define each yellow rust resistance, the Yellowhammer wheat panel was screened for DNA variation associated with the resistance using the Breeders 35K Single Nucleotide Polymorphism (SNP) wheat array. Some 19,703 SNPs were identified and used in a Genome Wide Association Study (GWAS). This GWAS identified which yellow rust resistance genes were effective in each wheat variety across the multi-site by year field trials. We were able to identify 45 yellow rust resistance genes that conferred a good level of resistance over more than one location and year. Twenty-nine of these yellow rust resistance genes were present in over 90% of the wheat varieties making up the Yellowhammer panel, indicating that wheat breeders have done a great job in accumulation sources of yellow rust resistance in wheat over the past 60 years. However, yellow rust resistance genes that occurred in less than 25% of the wheat varieties were also discovered; 1A011 (18.5%), 2B153 (17.3%), UN004 (6.25%), 3B004 (21.7%) and *Yr15* (2.3%). As these yellow rust resistance genes have been used less frequently in UK and northern European winter wheat breeding, they represent a potential underexploited resource that could be used to improve yellow rust resistance in new wheat varieties.

Combining yellow rust resistance genes that confer resistance through different biological mechanisms is considered an effective way of optimising resistance. To this end the breeders developed near-isogenic wheat lines that were genetically identical except for one or more target yellow rust resistance genes (Figure 3). These NILs were then used to study the development of *Pst*, at the microscopic level, to determine differences in the way resistance genes functioned.

Assessment of the resistance 2A019 indicated that this yellow rust resistance primarily stopped the development of *Pst* at the formation of runner hyphae (Figure 4). The fungus was able to germinate and enter the wheat leaf, forming a

Figure 2. Yellow rust percentage infection levels seen across trial sites in 2022. SY_WH – Syngenta, Whittlesford; SY_CH – Syngenta, Centre-Val de Loire; KW_TH – KWS, Thriplow; KW_WE – KWS, Wietze, Niedersachan; LI_WO – Limagrain, Woolpit; LI_RO – Limagrain, Rothwell; RA_IC – RAGT, Ickleton; RA_LI – RAGT, Annoeullin; DS_WA – DSV, Waddington; SE_SE – Sejet, Syddanmark; LA_SV – Lantmannen, Svalov; LA_BJ – Lantmannen, Bjertorp

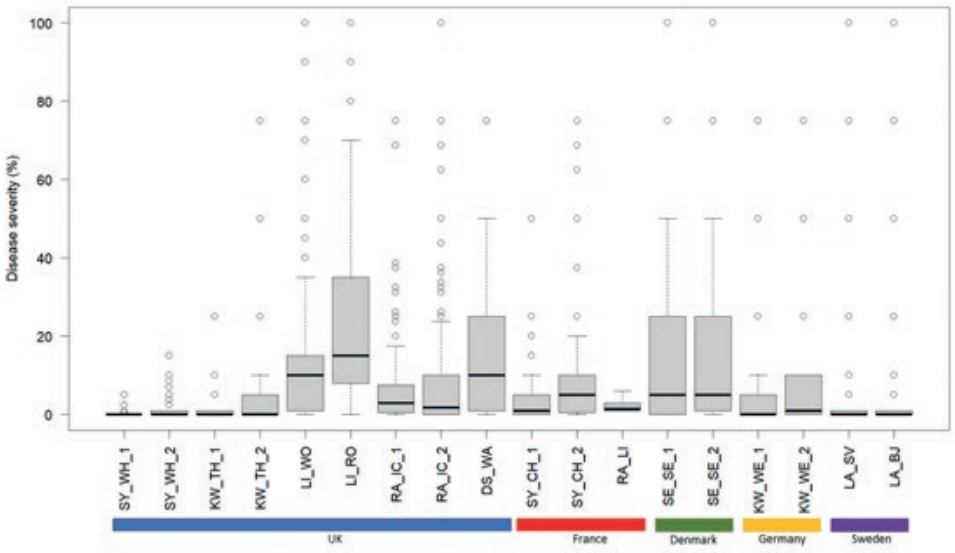


Figure 3. Yellow rust infection on wheat near-isogenic lines (NILs) containing defined yellow rust resistance genes. The NIL either contains yellow rust resistance 2A019 or 6A612, or no genes (none)

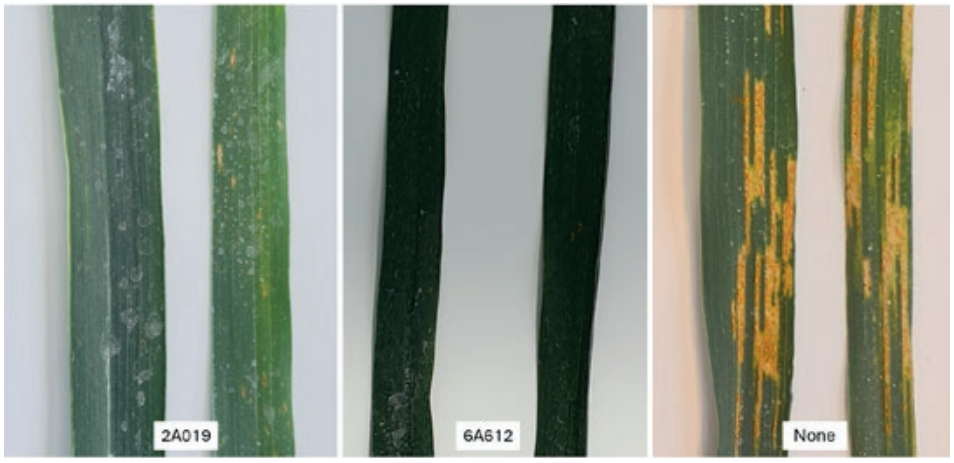
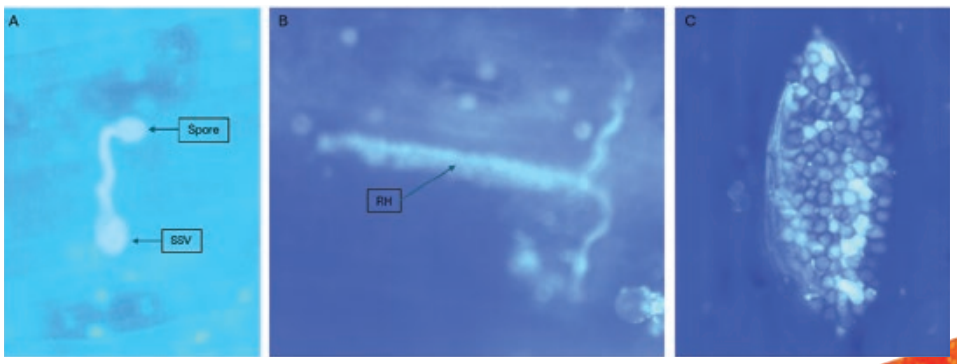


Figure 4. Microscopic development of *Puccinia striiformis* f. sp. *tritici (Pst)* on a wheat leaf. Images of *Pst* growth stages; A) germinated spore where germ tube has entered a stomata and formed a sub-stomal vesicle (SSV) within the leaf; B) fungal growth within the leaf, producing a runner hyphae (RH) that grows between the plant cells producing fungal feeding structures within plant cells; C) a yellow rust pustule breaking through the surface of the leaf and producing a mass of new spores



sub-stomatal vesicle within the stomatal cavity of the leaf, thereby establishing infection. However, in the lines carrying 2A019 the pathogen was less able to produce runner hyphae and spread through the leaf tissue. In lines containing the resistance 6A612 runner hyphae were able to develop, but the formation of pustules was greatly reduced (Figure 4).

The Yellowhammer project has provided wheat breeders with a holistic view of the sources of yellow rust resistance they have available to them within their winter wheat breeding programmes. This includes knowledge of resistances that are principally fixed in their wheat materials, as well as resistance loci that are underutilised, with some sources of resistance only being present in 2.3% and 6.25% of the wheat varieties, i.e., *Yr15* and UN004, respectively. The breeders have been able to use the SNP markers identifying these sources of yellow rust resistance to develop DNA markers that are diagnostic for each gene and use these in their breeding programmes to deliver new wheat varieties with effective yellow rust resistance. The microscopic development of the yellow rust pathogen has shown that different sources of yellow rust resistance interact with the pathogen in different ways, indicating potentially different resistance mechanisms. By combining resistances that function through different biological mechanisms it is believed that more durable resistance can be achieve.

Yellowhammer

Partners: NIAB, DSV, KWS, Lantmännen, Limagrain, RAGT Seeds, Sejet and Syngenta

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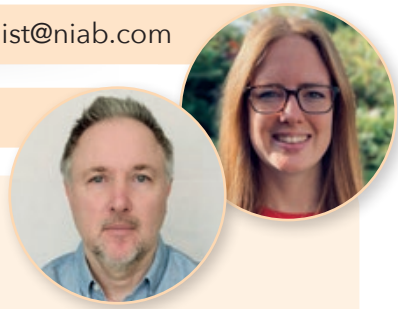

Septoria disease review of the 2022/23 season

Septoria is one of the most damaging diseases of wheat in northern Europe, and is caused by the fungal pathogen *Zymoseptoria tritici*. Current methods of combating this disease are mainly based on the use of fungicides and resistant varieties. As the reduced sensitivity to all major classes of fungicides in Septoria is established as a growing wide-spread problem (AHDB Project – *Monitoring resistance to foliar fungicides in cereal pathogens*. Available on ahdb.org.uk), breeding resistant varieties has become one of the priorities of the sector.

Dr Charlotte Nellist – see page 8.

Dr Kostya Kanyuka – see page 8.

During the past decade or so, a continuous but slow increase in the level of resistance of winter wheat AHDB Recommended List (RL) varieties has been observed. For instance, an average Septoria resistance score amongst the RL varieties increased from 5.2 to 6.2 since 2014. On the AHDB 2023/24 RL 19 out of 39 varieties had a resistance score of 6.0 or more (on the 1-9 scales, high figures indicates higher resistance) as compared to only three out of 37 varieties on the 2013/14 RL.

Varietal resistance to Septoria has been put to a true test by Mother Nature herself in 2023, characterised by exceptionally high disease pressure across most UK wheat growing regions due to favourable climatic conditions. First, an unusually warm Autumn 2022, with October and November being almost as warm as September, could be accounted for a high build-up of Septoria inoculum. That, followed by a period of cold weather in the winter, and almost continuous rain in March coupled with a lush available crop canopy, resulted in one of the highest Septoria years on record.

Due to a particularly wet March some fields, and even areas of the country, failed to receive a T0 fungicide spray, potentially further exacerbating the problem. There was plenty of Septoria seen in April on the lowest/oldest leaves of many RL varieties, including those with high resistance ratings such as KWS Extase (rated 7.8), perhaps with the exception of Theodore, Mayflower, and Champion rated 9.1, 8.9, and 8.1 respectively. However, there is plentiful anecdotal evidence that Septoria resistance in many modern winter wheat varieties could be expressed more at the adult stage. NIAB is a partner in ATTILA, a new research project led by INRAe in France, working with wheat breeders, that aims to identify the genetic determinants of this potentially more durable adult plant Septoria resistance.

And so, 2023 was set to be a disastrous year in terms of the level of Septoria. However, the overall impact on UK wheat production due to the early season epidemic was not very dramatic. This may be due to the expression of adult plant resistance but also the very low rainfall and hot weather in June (another unpredictable consequence of the changing climate) limiting disease spread.

This rather rapid and prolonged rise in temperature, and a lack of moisture, was one of the hypothesised causes for the unusual disease symptoms observed by many wheat growers in Summer 2023, characterised by small, paper-coloured pycnidia-bearing lesions with sharp dark brown borders. The symptoms resembled those of Ascochyta leaf spot, induced by a fungal pathogen known as *Didymella exitialis* or *Ascochyta tritici*, which is sporadic and relatively uncommon in the UK. However, most of the leaf samples received by NIAB displaying these symptoms turned out to be caused by Septoria.

Growers are reminded that plant resistance is only 'one string in the bow' and reducing disease pressure by considering drill timing and location, and spreading risk by growing diverse varieties, as well as the correct timings of preventative fungicide applications are all advised proactive management plans.

Typical Ascochyta symptoms on winter wheat (left and middle) with atypical paper-like Septoria lesions with dark markings observed late season 2023 (right) (Left and middle image source: The encyclopaedia of cereal diseases, AHDB)

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Arresting the decline in pollinating insects on UK farms using wildflower seed mixes

Flower-rich semi-natural grassland is the main habitat that supports pollinators but, by 1984 in lowland England and Wales, the area had declined by 97% compared to the previous 50 years, with only 7,500 ha remaining by 2010. Between 2019 and 2023 NIAB was a partner of BEESPOKE, an EU-funded project, which sought to increase the number of pollinators and crop pollination on a local and landscape scale across the North Sea region.

The UK input to the work was led by NIAB's Michelle Fountain and her entomology team at East Malling, and much of the work focused on fruit crops. Fruit growers spend considerable time and energy on crop management techniques, but may not always give serious thought to their levels of crop pollination which can have considerable impact on crop yields and quality.

BEESPOKE was established to develop new expertise and tools for land managers and policymakers so that they can create more sustainable and resilient agroecosystems and improve levels of pollinators and crop pollination. The project developed new wildflower seed mixes, training materials to improve management of pollinators and measure crop pollination, and predictive land management software. Demonstration sites were also established, including one at NIAB's East Malling site, to provide feedback on the new tools.

Fruit crops can benefit from wildflower rich habitats, not only in the provision of pollinators to maximise yields, but also for the provision of beneficial insects which help to regulate populations of insect pests. Fruit farms therefore will benefit from the establishment of flower rich habitats, which can help to replace at least some of the semi-natural grassland area that has been lost. Nevertheless, many fruit growers share concerns that establishing wildflowers on their farms may lead to competition with their commercial crop for introduced pollinators and that wildflowers may also attract and harbour insects pests in the vicinity of the crop.

NIAB actively assessed and recorded the impact of wildflower strips over the life of the BEESPOKE project. It was found that wildflower mixes do not compete with flowering crops for commercially installed pollinators; a study using a fluorescent tracer demonstrated that commercial bumblebees visited the crop flowers far more than the adjacent wildflowers. Indeed, wildflowers adjacent to raspberry crops enhanced the number of insect pollinator visits to the crop. This would dispel any concerns commercial growers might have about wildflowers competing with their crop for pollinators.

Research in apple orchards demonstrated how over three seasons, with alleyway sowings of knapweed, yarrow, oxeye daisy, bird's foot trefoil, self-heal, red campion and red clover, tree populations of predatory spiders, hoverflies, anthocorids and lacewings increased, while numbers of codling moth and fruit tree red spider mite decreased. Aphids decreased in some years but not others, while rust mite increased in one season. In strawberry, the effect of

Figure 1. Wildflower demonstration area sown at NIAB's East Malling site

Scott Raffle is NIAB's Senior Knowledge Exchange Manager, raising the profile of the research and commercial activities at NIAB East Malling and improving collaboration between researchers and the fruit and wider horticulture industry.

Dr Michelle Fountain is NIAB's Head of Pest and Pathogen Ecology at East Malling, specialising in the minimisation of pesticide use in fruit horticulture, improving pollination in fruit crops and incorporating modern fruit growing practices with Integrated Pest Management.

Interreg North Sea Region BEESPOKE European Regional Development Fund EUROPEAN UNION

wildflowers on the numbers of thrips was mixed, with increases occurring in some years but not others, and most thrips recorded were not species damaging to strawberry. Further work is required in soft fruit crops to understand more about this relationship.

NIAB believes that there will be a greater impact of natural enemies if the wildflowers are positioned within the crop rather than around the field margin. By creating corridors of flower-rich habitat this will enable beneficial insects to move into and through crops, and most importantly for growers, onto the crop for pollination and pest control.

One of the aims of the project was to develop a range of seed mixes for planting on fruit farms to help reverse the decline in pollinators. These have been targeted at the types of pollinators needed by each crop type. Some were sown and demonstrated at East Malling (Figure 1). The benefits tend to increase with time following sowing and establishment of wildflower areas, and for this reason, perennial mixes tend to be more beneficial. The most significant impacts are seen from three to four years onwards with an increase in predator/prey ratios.

When setting about developing BEESPOKE wildflower mixes for different UK fruit crops, NIAB gave serious thought to the structure, size and composition of the areas to be established and how they should be managed.

It is important to include species that provide height to the mix, which provides improved habitat for insects and an increased biomass which is good for carbon capture. As a result, mowing should be kept to a minimum (Figure 2) and if it must be carried out, it is better to mow every other crop row or in the case of large wildflower areas, only half the area. Ideally, the height should be maintained at a minimum of 20 cm. If there has been little rainfall a single cut in the autumn may be all that is needed.

Although semi-natural habitats are important habitat for pollinators and beneficials, alongside ditches, native hedgerows and woodlands (for nesting and shelter), purpose-sown flora can be tailored to specific needs, so growers can gain a lot of pollen and nectar resource from a small area. Some studies

Figure 2. Mowing should be kept to a minimum

recommend a minimum of 6% natural habitat and ideally up to 10%. In addition, a total of 1 km of flowering hedgerow per farm can be sufficient to support six common pollinator species. It is generally felt that several small habitat rich areas are more beneficial than one large area for supporting butterfly and parasitoid species. Should one large area fail or be damaged in any way, there are no alternatives, so several smaller areas provide a fall back in case of failure of one. Different areas can also host different seed mixes to increase on-farm biodiversity.

The seed mixes should ideally provide diversity of species which complement wildflower species that are already present in or around the farm. The mix should provide flowers outside of the crop flowering period, thereby extending the provision of pollen and nutrients, which can maintain insect population stability and fecundity. Late flowering species help insects to complete their lifecycle thereby helping them to survive from year to year.

When developing an optimum seed mix for each fruit crop, the scientists considered which bee (Figure 3) and hoverfly species most commonly visit the crop, which non-crop flowers they visit most often, and which are likely to thrive in a sown area or regenerated strip. NIAB undertook literature searches to identify the pollinators that visit each crop and ranked them according to the frequency of their visits. Having chosen the top five or six pollinators, the research team considered the non-crop wildflowers most commonly visited by each pollinator and produced a final choice of seed for each fruit crop including annuals, perennials, biennials and weed species that will attract the five or six pollinators. Not all species will thrive on every site, and for each mix, there is a caveat that some flowering species may have potential to harbour crop pests or diseases, allowing growers to make informed decisions about their final choice of mix.

Some flower species were included repeatedly in a number of the crop mixes, including bird's foot trefoil, dead nettle, clover, yarrow, hawksbeard and dandelion. Some are long flowering species and some are late flowering.

NIAB has now produced guides to selecting suitable seed mixes for all UK fruit crops and these can be found on the BEESPOKE website at: https://northsearegion.eu/beespoke/. In addition, other very helpful guides, evaluation tools and publications for growers have been produced as part of the project and are available on the website, including 'Monitoring pollinators', 'Estimating pollination potential', 'Establishing perennial wildflower areas' and 'Supporting pollinators and farmland biodiversity'.

Figure 3. NIAB considered which bee species most commonly visit the crop

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.

It gives these enterprises an opportunity to outline their vision and plans for new products and services – for this issue we welcome **SoilWater Ltd**.

Through initiatives such as Barn4 and Growing Kent & Medway, 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.

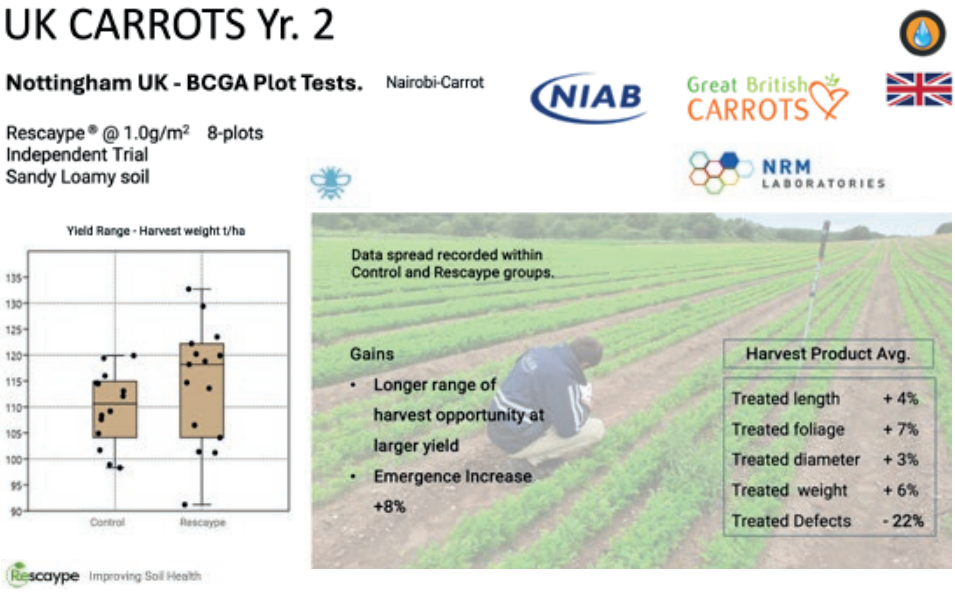
Precision soil conditioning

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

SoilWater Ltd, based in the UK, focuses on the sustainable management of soil and water resources. Our mission revolves around the innovative use of our proprietary product, Rescaype, which is a micronised, instantly soluble precision soil flocculant-conditioner. As pioneers in integrating Environmental, Social, and Governance (ESG) principles and circular economy practices into precision agriculture, we aim to ensure the longevity and health of soil and water systems worldwide.

How does your product/service benefit the agriculture industry?

Rescaype is the cornerstone of our product lineup, a 150 micron crystal setting a new standard in precision soil conditioning. Its ability to dissolve instantly and activate sets it apart, that we see as a game-changer for the agriculture industry. With an application rate of 10 kg/ha, Rescaype delivers a three-year return on investment. Beyond its financial benefits, Rescaype enhances soil structure, increasing water penetration and absorption allowing increased nutrient accessibility, particularly nitrogen. It improves the



Soil Health Index and promotes natural increases of microbial biomass, thereby contributing to healthier plant growth. Furthermore, Rescaype can be installed to act as a phosphorous barrier, reducing diffuse pollution by up to 90%. It can help desalinate soil in less than 21 days, prevent diffuse pollution and soil leaching of nutrients per the Defra ELM's-SFI targets.

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

We used NIAB's contract field trials services in 2020 to carry out independent plot trials of our Rescaype product. This helped validate Rescaype's efficacy as a soil improvement product and confirmed its potential for long-term yield enhancement.

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

Joining Barn4 was a strategic move to align with a centralised Innovation Hub, fostering a community of information exchange and innovation in agriculture. This partnership has been instrumental in our growth, offering insights into current R&D trends and facilitating connections with key stakeholders in the agricultural sector. The support and resources provided by these networks have been invaluable in developing our startup, enabling us to better understand land management needs and engage with agricultural innovators.

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Staff profile – Dr Belinda Kemp

Dr Belinda Kemp joined NIAB as Group Leader of Viticulture & Oenology research, at the East Malling site, in April 2023. Prior to this Belinda spent a decade working in Canada as Principal Scientist researching the practical aspects of sparkling wine production and has also worked in commercial wineries in New Zealand and the UK. NIAB Landmark finds out a little more about Belinda and about her work in growing NIAB's viticulture and oenology capabilities.

How did you get into viticulture?

I love wine! Who doesn't love drinking wine? And as soon as you start learning a little bit about wine, you want to learn more and more. That bottle you buy off a shelf in a supermarket that you thought was quite simple suddenly becomes far more complicated – especially when you start exploring the chemistry, the science, the viticulture, the soil, and all aspects of microbiology. I don't think there's any one aspect of wine making that doesn't fascinate me.

What have you been working on since joining NIAB?

As well as currently working with some disease resistant varieties and looking at the impacts of different vessels, a lot of my time has been spent on getting the Wine Innovation Centre up and running. It was an empty building when I arrived, but now it's the only wine research centre in the UK that has been set up specifically to meet the grape and wine industry's needs. It's packed full of state-of-the-art equipment that will allow NIAB to carry out extensive research work all the way from the grapes to the wine, allowing us to understand the impact that vineyard interventions have on the characteristics of the wine.

In addition, we've just launched our first membership scheme – the NIAB Vine Club. We plan to work with UK grape growers, ensuring the industry benefits directly from our cool climate focused, scientifically robust viticulture research.

What do you think are the main challenges facing the UK wine industry?

Whatever you do in the vineyard affects the wine – you're making wine from the crop, not picking it and eating the fruit straight away. So the long-term effects of whatever you do in the vineyard, not only on the vines but also on the wine, is extremely important. And, therefore, wine tasting and understanding wine chemistry as well as the concepts of viticulture are equally important.

There are many challenges around Net Zero and sustainability issues; while there are many potential solutions, many are untried, so we need to tackle them to be able to meet the Net Zero targets.

We're also delving into aspects of regenerative viticulture to ensure that practices that are used by vineyards are based on scientific evidence. Growing food and crops more sustainably is hot topic currently, and viticulture is no different. As a result, NIAB has some trials currently ongoing in the research vineyard, most notably looking at the impact of cover crops, managed by my colleague, Dr Flora O'Brien.

What's the best thing about working for NIAB?

I think it's the freedom. There's an incredible freedom to explore, not just for ourselves but for wineries and vineyards as well. They may not want, or be able to do that in their own vineyard or winery but it's something that we can do here extensively and, with the Wine Innovation Centre and new membership schemes coming on board that's only going to get better.

For more information on the Wine Innovation Centre, membership options via The Vine Club and other future viticulture membership schemes, plus Open Days and Events go to niab.com.

Glasshouse Services

Testing beyond the field

Glasshouse facilities

Our glasshouse facilities at Cambridge and East Malling (Kent) reflect modern commercial services and feature:

- Offer a complete bespoke package from trial design, trial delivery, data collection, analysis, and reporting
- Approximately 6,500 m² of controlled environment glasshouses and specialist plant growing facilities combined across the sites including spore-proof growth rooms, growth chambers, containment and vertical farm unit and vernalisation areas
- Ability to provide small pre field scale trials supporting R&D and proof of concept projects.

Glasshouse capabilities

- Biostimulant trials
- Nutrition and water management
- Seed bulking
- Fertiliser and crop protection products
- Herbicide efficacy trials
- Growing media trials.

NIAB glasshouse services include:

- Experimental design
- Impartial assessment
- Phenotyping
- Data handling and analysis
- Genetic resource maintenance
- Specialist plant husbandry
- Additional analytical services available via NIAB LabTest

Testimonial:

"We are a young start-up company with no track record in agriculture. When we mention that we are undertaking trials with NIAB, we get a positive response from potential customers or partners. Working with NIAB helps us to demonstrate that we want to produce robust evidence about our product that stands up to scientific scrutiny."

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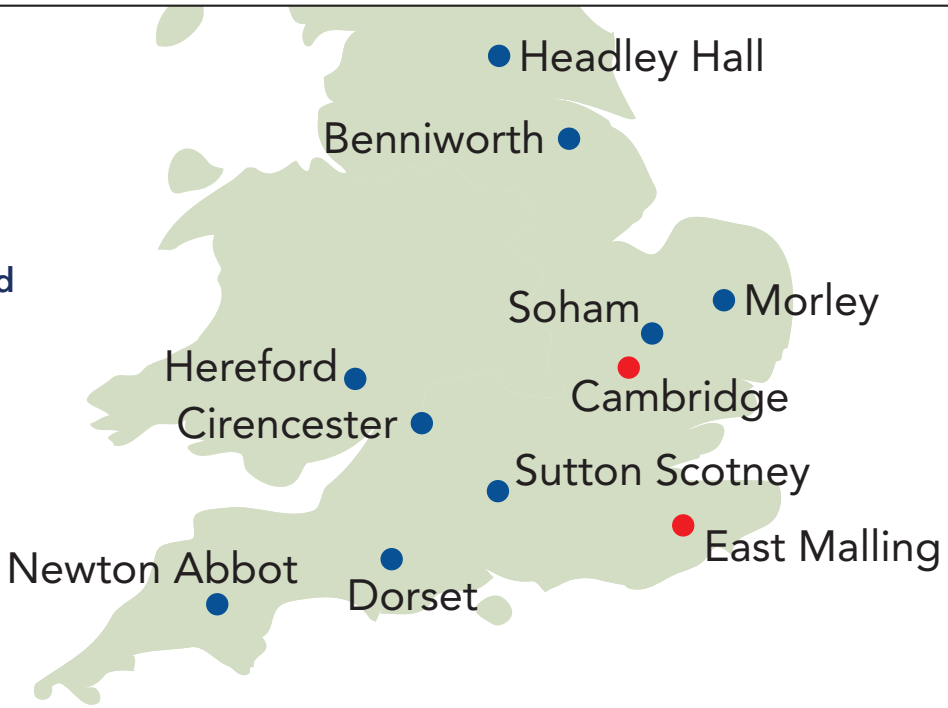

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Edited and published by NIAB. Designed and produced by Cambridge Marketing Limited, 01638 724100