

Landmark



**What's possible.
What's practical.**

**CEO Katrina Hayter on closing the gap
between science and farming**

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Meeting the challenge: why Niab matters more than ever

I have spent my career on almost every side of agricultural innovation. I started as a plant scientist. I have helped new crop technologies navigate regulators, funded research and innovative companies as a public investor, and, at HSBC, looked at farming and the food system through the eyes of a lender. Each role taught me something different. But one lesson ran through all of them: the UK is extraordinary at discovering things, and much less good at getting them onto farms.

That gap between discovery and deployment is why I came to Niab. Niab is not simply a research organisation, nor is it simply an advisory or testing organisation. We work across the whole crop production system, connecting fundamental science with breeding, trials, testing, agronomy and knowledge exchange, and with the needs of farmers and growers.

Closing that gap matters more than ever. Pressures on crop production have rarely been more complex: shifting markets, rising input costs, unpredictable weather, evolving regulation and environmental expectations, new pests and diseases, and supply chains demanding more from agriculture. At the same time, advances in genetics, data, automation, crop protection, soil management and artificial intelligence are opening new

possibilities. The challenge is turning them into solutions that work in the real world.

Systems, not silos

We tend to talk about farming's challenges in separate boxes: productivity in one, the environment in another, profitability in a third, and climate resilience in a fourth. Policies, funding streams and markets are often organised in the same way.

But a field does not work in boxes. It is where food production, soil health, water, biodiversity, carbon and the farm business all meet. That is a challenge, because a decision in one area affects all the others. It is also a huge opportunity, because the right intervention can pay back several times over.

Take rotations. Our long-term farming systems work suggests that changing the rotation itself can have a greater effect on margin than changing the cultivation system. A better rotation can also break pest and disease cycles, reduce input costs, improve soil structure and help crops cope with a difficult season. One decision, many returns.

Or consider genetics. A variety with stronger disease resistance can cut fungicide costs, reduce emissions and pollution, and lower the financial risk of a bad disease year, all without taking an acre out of production. That is the kind of thinking agriculture needs now: seeking interventions that deliver for productivity, nature and profitability at the same time, and being honest about where real trade-offs remain.

Katrina Hayter joined Niab as Chief Executive in September 2026. A plant scientist by training, she holds a PhD in Biosciences, an MSc in Ecology and a BSc in Plant Sciences. Her career has spanned the full journey from science to market: at DuPont Pioneer, she took crop technologies through regulatory systems in Europe and around the world; at Innovate UK and UKRI, she led the Transforming Food Production and Defra Farming Innovation programme; and most recently at HSBC, as Global Head of Sustainable Agriculture, Land Use & Food. At Niab, she is focused on strengthening the organisation's role at the interface between science and agriculture, ensuring research and innovation deliver practical value for farmers and growers while building resilience in UK crop production.

The gap between promise and practice

Here is a statistic that has stayed with me. Over the past three decades, the genetic yield potential of new wheat varieties has continued to rise. Yet wheat yields on farms across north-west Europe, including the UK, have been broadly flat since the mid-1990s. Recent research published in *Nature Food* found that the limit is not in genetics or climate; it lies in how crops are managed on farm.

The genetics are arriving, but they are not yet being fully realised in the field. That is not a criticism of farmers; it is a sign of how complex modern crop production has become and how much the right variety depends on the right system around it.

Our work on hybrid wheat, included in this issue of *Landmark*, is a good example. Hybrid wheat could deliver higher yields and greater stability under stress. But promising technology is not the same as a proven solution. Claims about drought tolerance and resilience need to be tested under



Niab leads in connecting science and farming through a valuable programme of knowledge exchange and grower engagement

UK conditions, against the alternatives growers already have. Farmers need to know not only whether something works, but also whether it works on their soils and in their rotation, and whether the benefits justify the cost.

Turning climate science into farm decisions

Climate change makes this systems view even more important. The past few seasons have brought the issue much closer to the farmgate, with increasingly unusual combinations of heat, drought and rainfall. As colleagues at the Met Office explain in an article in this issue, climate risk is not simply about hotter summers or wetter winters. It depends on how heat, drought or waterlogging coincide with a crop's stage of development. The same temperature can matter very little at one stage and a great deal at another.

The job is to translate that sophisticated science into practical decisions on varieties, traits, rotations and agronomy, made today rather than in 20 years' time. There will rarely be a single answer, and silver bullets are rare. Resilience will come from combinations: the right genetics, in the right rotation, managed the right way.

Making the economics work

My time in finance taught me something farmers already know: changing a farming system has a cost, and the farmer usually carries it. Many changes follow a J-curve, with a dip in returns for several years before the benefits come through, while many of those benefits flow to the supply chain and society. That is why



Niab has a key role in translating science into practical decisions on varieties, traits, rotations and agronomy

independent evidence matters so much. It gives farmers confidence to change. It helps government target support at what actually works. And it gives buyers, lenders and investors something they can rely on. Evidence is what turns a good idea into something adoptable.

Listening to farmers

None of this works without farmers at the centre. As our former Deputy Director, Stuart Knight, reflects in his final article for Niab and featured in this issue, farmers have always worked together to test ideas and solve problems. What has changed is the scale and complexity of the questions. Farmers are being asked to raise productivity while lowering environmental impact, manage greater weather variability and demonstrate the sustainability of what they produce. No single farm, organisation or discipline can solve that alone; it takes farmers, researchers, breeders, businesses, policymakers and advisers working together. Farmer-led initiatives such

as ADOPT show how practical, on-farm testing can help answer them, and our research into farmers' own priorities will help make sure our work focuses on what matters most to them.

A changing Niab

This is also the context for the changes taking place at Niab as we near the end of a period of reorganisation. For me, it is not about boxes on an organisation chart. It is about organising Niab around the questions agriculture faces, and connecting our expertise across crop improvement, cropping systems and independent testing, so we can look at how genetics, agronomy and systems perform together, not one at a time.

I want Niab to be outward-looking, collaborative and relentlessly focused on impact: ready to work with anyone who can help answer the important questions facing agriculture, while retaining the independence and scientific integrity that make Niab unique. Research only creates value when it is used. A new trait has to make it into a useful variety, a new technology has to be tested, and evidence has to reach the people making decisions.

Looking ahead

I have only been at Niab a short time, but I have already seen enormous commitment from our people to exactly this work. The pressures on agriculture are real, but so is the opportunity. The UK has an exceptional science base, a highly capable farming sector and a crop research ecosystem with real strengths. Niab sits at the point where those things meet.

Our task is to help close the gap between what is possible and what happens on farm: anticipating challenges rather than simply responding to them, testing ideas rigorously, challenging assumptions, and finding the solutions that pay back many times over, for the farm business, for nature and for long-term resilience. And to do it alongside farmers and growers, not simply for them.

That is the Niab I want to help build: one that connects science, technology and practical agriculture, turns evidence into action, and helps UK crop production stay productive, profitable and resilient in a rapidly changing world.

There is plenty to do. I am looking forward to doing it with you.



Niab CEO Katrina Hayter talking to farmers and growers at Cereals 2026 this summer



Farmer collaboration: past, present, and future

First announced at the Oxford Farming Conference in January 2026, and following a series of workshops with farmers and land managers to help shape the scheme, Defra has recently provided an update and early guidance on the Farmer Collaboration Fund (FCF). This government initiative, with a budget of £30 million, will support existing and new groups of farmers, growers, and other land managers in England in working together to manage land in a productive, sustainable, and nature-friendly way.

Organisations based in England can apply for funding to act as delivery partners, who will facilitate farming collaboration groups that must include farms. Initial guidance is that each delivery partner must support at least five groups, with at least four separately managed farms in each. With the first round opening on 1st September 2026, agreements are expected to last three years. Further rounds are expected to open in 2027 and 2028. The fund is not open to applications from individual farmers, growers, land managers, or group facilitators.

Based on their geographic location, farming sector, and area of expertise, delivery partners will support their groups by sharing knowledge and experiences, peer-to-peer learning, and trying new working practices, with a focus on practical, farm-led approaches. This could also then facilitate the

development of landscape-level projects, or applications for larger land management schemes.

The FCF follows the announcement of further funding rounds for the ADOPT (Accelerating Development of Practices and Technologies) funding scheme. This has already supported a series of collaborative farmer-led projects involving on-farm trials to test and demonstrate new practices or technologies that could provide practical solutions to current productivity, sustainability, or resilience challenges on farm. Issue 60 (Spring 2026) of *Landmark* highlighted Niab's role in facilitating and partnering on a number of ADOPT projects, with further projects since funded and now underway.

Of course, collaboration between farmers and growers is not new. Farmer-led groups, operating independently or linked to a research or knowledge

Stuart Knight, former Niab Deputy Director and Director of Agronomy, recently retired from Niab after more than 35 years, working as a research agronomist and supporting members at the North of England Arable Centre, Arable Research Centres, The Arable Group, and Niab.



exchange organisation, have existed in one form or another, for many decades.

Within the arable sector, the 1980s heralded a period of rapid growth in regional, farmer-driven applied research and knowledge exchange, focusing on the agronomy of combinable crops. Today's annual *Cereals Event* grew out of *Barley '79*, established with help from Professor John Wibberley, at the Royal Agricultural University in Cirencester, to share how four farmers had doubled their winter barley yields. Shortly after, the Cotswold Cereal Centre brought together a group of local growers to collaborate on improving cereal crop husbandry and performance through trials on members' farms and knowledge sharing. The Cotswold Centre was soon accompanied by similar centres in Hampshire, Kent, Lincolnshire, and Cambridge, which together became Arable Research Centres (ARC). About the same time, the North of England Arable Centre (NEAC) was formed, bringing together growers across the north-east of England, and supported by staff in the Department of Agriculture at the University of Newcastle.

Meanwhile, there was a rich history of arable research and knowledge exchange in Norfolk, dating back to the start of the 20th Century as the Norfolk Agricultural Station (NAS) and from 1965 as Morley Research Centre





(MRC). Collaborations with charities such as the Felix Thornley Cobbold Trust at Otley and the JC Mann Trust later expanded activities to Suffolk, Essex, and the wider Anglia region. The founding of NAS itself was linked to the Stalham Farmers' Club (www.stalhamfarmers.co.uk), one of several that existed in the mid-1800s.

In 2003, ARC (which by then included NEAC) joined with MRC to create The Arable Group (TAG). This enabled coordinated, farmer-led, on-farm agronomy research, trials, and peer-to-peer knowledge sharing and learning from Kent to Cornwall to the Scottish Borders. At the end of 2009, the joining together of TAG and Niab added members from the Niab Association, and breadth and depth of knowledge on varieties and seeds.

Through these and other cooperation routes, thousands of farmers, agronomists, and industry technical specialists have come together over the years with the collective aim of increasing crop productivity; assessing the potential of new varieties, management approaches, and technologies; and addressing ongoing or emerging economic, agronomic, and environmental challenges.

The role that collaboration between farmers (and other stakeholders) might play in helping to simultaneously improve agricultural productivity, reduce negative (or increase positive) environmental impacts and enhance social benefits was explored in 2014-17 as part of the Defra and Welsh Government funded Sustainable Intensification Research Platform. The research highlighted higher levels of cooperation between farmers than previously perceived, especially

informal ways of working together, such as sharing machinery. Key drivers were financial factors and mutual support through knowledge exchange, with environmental benefit less likely to drive cooperation. Social rather than economic factors were most often identified as enablers. Unexpected costs of participating in initiatives were found to be the most significant economic barrier to collaboration, with strong coordination vital to ensure relationships do not become strained.

The Farmer Cluster initiative (www.farmerclusters.com), first piloted in 2014 by the Game and Wildlife Conservation Trust, in partnership with Natural England, fostered the coming together of neighbouring farms to improve wildlife habitats at a landscape scale, coordinated by a trained facilitator and fuelled by shared local knowledge. This has grown to more than 200 clusters across Great Britain. Building on the approach that had developed in England, the FRAMEwork project, funded under the EU Horizon 2020 scheme, established eleven farmer clusters with diverse farming types and landscapes in nine countries across Europe, to expand testing of the concept. The researchers found that governance, leadership, facilitation, group characteristics, and context all affected the functioning and trajectories of the clusters.

The new funding and promotion of collaboration between farms and farmers to achieve productive, sustainable, nature-friendly farming is undoubtedly very welcome. However, there is much to learn, and build upon, from past studies and especially from the wealth of existing farmer cooperation and collaboration, whether 'bottom-up' local clusters or

regional and national farmer and grower networks.

I have been fortunate to have worked with groups of farmers and agronomists for more than 35 years. On so many occasions, discussing in a field or debating in a meeting room, a problem shared has been a problem halved, and sometimes solved there and then. The knowledge that those groups have exchanged, their kinship, and their enthusiasm to work together towards a common goal have been invaluable to me and to the organisations that I have been part of over the decades. Long may they continue.

Find out more

Farmer Collaboration Fund

<https://www.gov.uk/government/publications/farmer-collaboration-fund>



ADOPT

Find out more about ADOPT funding

Farming Innovation

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ADOPT Support Hub

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applied climate scientist, and

Andrew Cox is a climate science
communicator and applied
scientist.

From projections to practice: what climate data means for UK crop resilience

After the UK recorded its warmest summer on record in 2025, growers faced an even hotter summer in 2026, as well as the driest July on record for England and Wales. The impacts of climate on UK agriculture are therefore at the forefront of many growers' minds. While each season is different, in the space of a generation, the UK's climate has changed significantly. Since the 1971-2000 period, the average temperature of the UK has increased by approximately 1.5°C (Figure 1). We are also seeing an increasing trend for wetter winters, including the wettest UK winter on record in 2023/24.

These changes are already having real-world consequences, leading to shifting crop phenology, changing pest and disease pressure, and impacts on productivity. In the coming decades, the climate will continue to change, bringing hotter, drier summers, warmer, wetter winters, and more frequent and intense weather extremes (Figure 2).

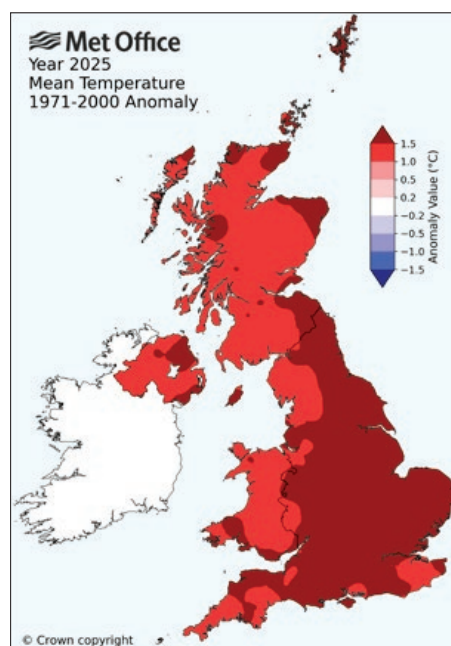
However, understanding what climate change means for agriculture involves more than just knowing whether conditions are becoming warmer or wetter. It requires looking beyond seasonal averages to examine how specific climate hazards interact with crop vulnerabilities.

This article describes the work of the Met Office in partnership with four of the Defra-funded Genetic Improvement Network (GIN) projects (WGIN, OREGIN, PCGIN and VeGIN, for wheat, oilseeds, pulses, and vegetables respectively), in order to better understand the risks and opportunities that will be faced by growers in the future, enable effective adaptation

of farming systems, and support a productive and resilient UK food system.

Climate change is altering the conditions under which UK crops are and will be grown. For some regions, warmer

Figure 1. Difference of 2025 average temperature to 1971-2000 average temperature. From Met Office HadUK dataset



temperatures and longer growing seasons may create opportunities, increasing the suitability of varieties that currently struggle in cooler conditions, widening options for diversification, or changing where existing crops can be grown most successfully.

However, as well as opportunities, there are increasing risks, and climate trends can create benefits in one part of the season but risks in another. A warmer climate is also associated with a greater risk of damaging extreme heat events; a longer growing season can be disrupted by drought, waterlogging or late frosts; and wetter winters can affect soil conditions, field access, and disease pressure. Changes in the climate are also likely to alter both inter-year and year-to-year variability, with the potential for more frequent swings from one extreme of weather to another.

While long-term trends alter the overall climate suitability for different crops, as well as associated pests and diseases, it is also important to interpret climate information through a lens of crop vulnerability and understand whether climate hazards coincide with the points in the crop cycle when plants are most sensitive. This makes the timing and duration of weather extremes, as well as their severity, critical to understanding future crop resilience.

Whether warmer, drier, or wetter weather may help or hinder yield and quality depends

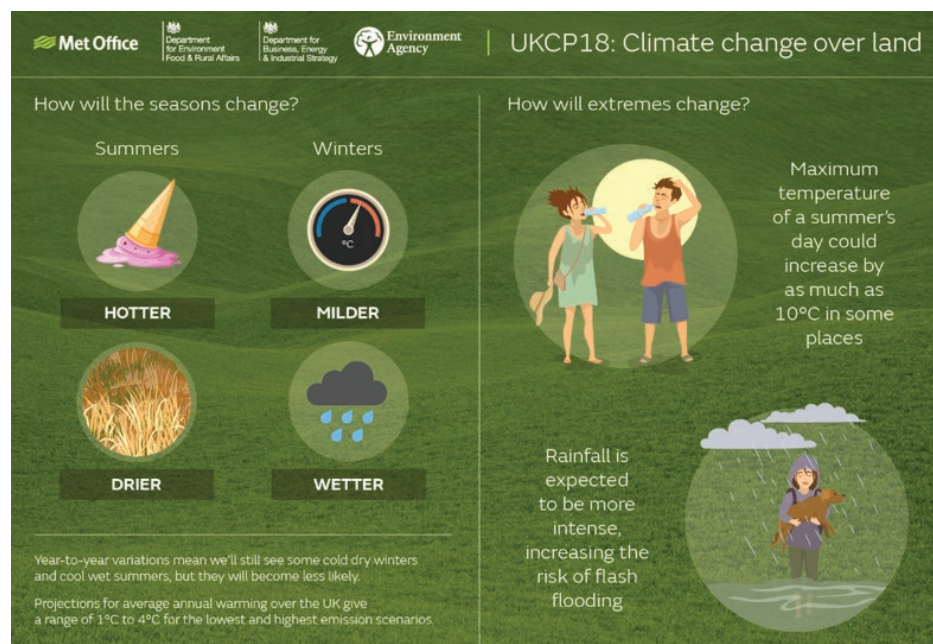
critically on the crops in question, the growth stage at which those conditions occur, and how far conditions depart from normal. For example, warmer temperatures early in the growing season can be beneficial by reducing the risk of frost damage, while heatwaves around the anthesis period can reduce grain set and yield.

The contrasting yields for wheat in the UK in 2018 and 2022 demonstrate this nuance. Both were exceptionally warm summers with very similar seasonal average temperatures, yet wheat yields differed markedly, with 2022 being one of the stronger wheat harvests of recent years while 2018 produced a less favourable harvest. One contributing factor was the timing and level of persistence of heat and drought. In 2018, prolonged hot and dry conditions extended from late spring into the first half of summer, while 2022 was notable for its exceptionally hot but relatively short-lived heatwaves much later in the season.

The work of the Met Office with the GINs has focused on exploring these interactions between climate extremes and periods of crop vulnerability by bringing together climate scientists with crop researchers and breeders from organisations including Niab, the John Innes Centre, Rothamsted Research, the University of Warwick, the University of York, and PGRO. Initial collaborative work helped clarify how climate change will intersect with different crop development phases throughout the growing season and allowed identification of a range of climate hazards and thresholds that are particularly important during sensitive stages of crop development.

This kind of knowledge can then be combined with climate projections to assess how the likelihood of agriculturally relevant risks may change in future. Many crops are especially vulnerable to high temperatures during flowering and seed development, although the temperature at which impacts become significant varies by crop, as does the time of year at which crops reach the reproductive phase. For example, in field peas, temperatures above 30°C can cause flower, fruit, and seed abortion, leading to substantial

Figure 2. Met Office UKCP18 Headline messages, UK Climate Projections 2018 (UKCP18), Met Office Hadley Centre



yield losses. Figure 3 illustrates projected changes in the frequency of heat stress events such as this in June and July, when field peas are in their reproductive phase. While such events have historically been relatively uncommon across much of the UK, the exceptionally hot summer of 2026, which reduced pea yields in some areas, provides a recent reminder of their potential impact. Climate projections indicate that conditions associated with this type of heat stress could become substantially more frequent across many of the UK's principal arable regions by the middle of the century.

One of the clearest findings, though, is that there is no single priority climate risk for UK agriculture. Analyses across the GIN crops highlight a range of future risks, including heat stress, drought, excess rainfall, flooding, and waterlogging, whose significance varies depending on the crop. At the same time, climate change may also create opportunities, including improved suitability for some crops and varieties, reduced frost risk in some regions, and potentially longer windows for field operations at some times of the year.

Quantifying these changing risks is only the first step. The real value comes from using this information to guide decisions about future crop development and management. By understanding how climate hazards are

likely to change and how those changes will intersect with crop calendars; growers, breeders, and researchers can make better-informed decisions about how to prepare for future conditions.

For growers, climate risk information can support future decisions around changes to existing crop choices, rotations, and management practices. Understanding how the likelihood of drought, heat stress or excessive rainfall may change can help identify where existing systems are resilient and where adaptation may be needed. In some cases, this could mean selecting varieties better suited to future conditions. In others, it may support longer-term decisions around diversification, irrigation investment, or land use.

For breeders, understanding future climate risks helps identify the traits that are likely to become increasingly important. Heat tolerance, drought resilience, resistance to emerging pests and diseases, and the ability to maintain performance under variable conditions may all become higher priorities as the climate changes. By linking crop vulnerabilities with future climate projections, research can help focus breeding effort on the characteristics most likely to support future productivity and resilience.

Perhaps most importantly, for researchers, this work helps create a common evidence base for discussion

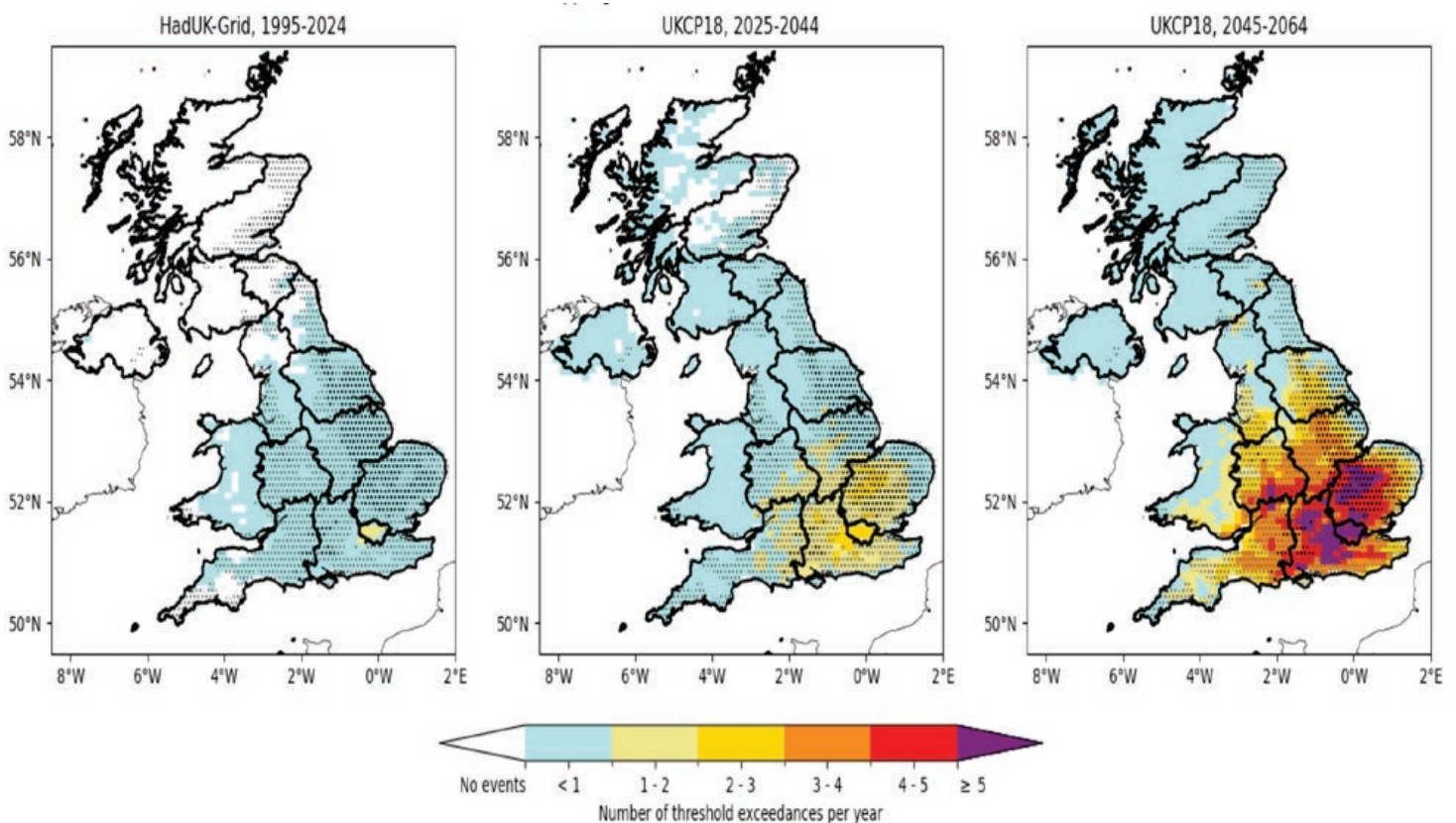
between climate scientists, breeders, and growers. Effective adaptation requires a shared understanding not only of how the climate is changing, but also of what those changes mean in practical terms for crop production.

This evidence points to a clear

conclusion: building climate resilience in UK agriculture will depend not only on understanding when and how weather hazards affect vulnerable crops, but on using that knowledge to inform practical decisions. By combining climate science with crop expertise, it becomes

possible to move from projections towards practical decisions. In doing so, growers, breeders, and researchers can better anticipate future risks, identify opportunities for adaptation, and help build resilient cropping systems capable of thriving in a changing climate.

Figure 3. Projected changes in the frequency of heat stress events relevant to field pea production. Colours show the average number of occurrences per year where the 3-day average maximum temperature exceeds 30°C during June and July, a period that overlaps with flowering and seed development in field pea. Stippling indicates major arable and horticultural production areas. Left panel 1995-2024 (HadUK-Grid observations), middle panel 2025-2044, right panel 2045-2064



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Dr Wright is a research group leader at Niab, with a Cambridgeshire farming background and diverse experience in crop quantitative genetics and physiology. Tally focuses on applying statistical genetics methods to uncover how genetic variation controls complex crop traits.

Hybrid wheat: a new dawn for drought tolerance in UK crops?

Compared with conventional varieties, hybrid wheat can offer higher grain yields. However, there is also an assumption in crop breeding that hybrid wheat is more drought-tolerant. If this holds true, hybrids could offer an attractive option for UK farmers looking to combat the challenging growing conditions exemplified by those faced on-farm over the past two seasons.

A wheat F1 hybrid is seed produced by crossing two inbred varieties. When grown, F1 seed can offer superior performance over its parents, a phenomenon termed heterosis. Previous research shows that heterosis can translate into grain yield increases of up to 15%. Less understood is how heterosis impacts other traits, where improvements are needed for future-proofing varieties against recent extreme weather conditions.

Extreme weather conditions for UK growers are becoming the 'norm', and records are continually being broken. In three out of the last five years, drought has been declared. Farm performance data from AHDB this year shows that the limited rainfall in the UK since spring 2026 contributed to highly variable wheat yields, ranging from 3.9 t/ha to 11.5 t/ha, with average yields below

the ten-year average for a second year running. Current UK wheat varieties appear susceptible to drought, and with conventional varieties taking around 10 years to develop and release, immediate solutions remain far from farmers' fields.

A closer solution may be at hand. Over the past few years, many European breeding companies have shifted focus from conventional varieties to hybrid wheat. Hybrids offer an attractive cost recovery model for plant breeders. However, the wheat reproductive system has evolved for predominantly self-fertilisation, making it difficult to form hybrids en masse. New scientific discoveries appear to be overcoming these issues and are allowing cost-efficient production of hybrid seed in high quantities.

A new generation of hybrid wheat varieties is not far off release in the UK.

Described as "Europe's first commercially scalable hybrid wheat", Syngenta has released a new line of hybrids called X-Terra® in France and is targeting release for the UK in autumn 2027. Several breeding companies are starting to promote their hybrid wheat programmes, and these marketing campaigns typically indicate these similar benefits:

- improved grain yield and yield stability;
- enhanced stress resilience;
- improved root structures and better performance under water-limited conditions.

Previous scientific research in Germany and South Africa supports some of these claims, with hybrids showing improved stability across different environments. However, further independent research in the UK is needed to validate these findings. Such experiments on UK farms with adapted hybrids would help growers decide whether switching from conventional varieties is worth the cost.

The past two growing seasons posed a good opportunity to compare hybrid performance against conventional varieties from the AHDB Recommended List. However, these experiments require hybrids adapted to UK conditions. As these become available, it will be possible to compare performance in more marginal conditions and under increased drought stress, while underpinning what specific characteristics are linked to enhanced yield potential. So, while the prospect of independent performance evaluation of adapted hybrids under drought conditions is yet to be realised in the UK, indications suggest this will change in the next few years.



Niab trials of experimental F1 hybrid wheat, developed by the University of Hohenheim, using Niab pre-breeding material as females



Will Vaughan-France is Niab's regional agronomist covering the southwest and is also the membership services development lead. He is based in Somerset, runs his own farm, and has experience across a range of technical and commercial organisations.

The price of uncertainty

Farm profitability has regularly featured in headlines in 2026, particularly following the Government publishing Dame Minette Batters' Review of Farm Profitability in mid-December 2025. This article examines how variability in market pricing, yields, and input prices is affecting the stability of arable farm profits.

The Defra-funded Farm Business Survey provides a dataset on the profitability of UK agriculture. The mean net income from cereal cropping farms in the UK in the past 10 years has been £98/ha, but the 2023/24 and 2024/25 financial years showed losses averaging £108/ha over the two years.

Output markets

The value of grain commodities is fundamentally affected by factors outside of the UK domestic market. Whilst the basic laws of supply and demand control the general global prices, this is not just about the size of the global harvest or where needs to buy, but also whether those grain stocks are available to the market. For example, recent upward movement in wheat prices is not because there is a lack of wheat stocks in Russia or Ukraine but because the war and destruction of export facilities mean grain has not been available to the market. Geopolitics is now just as important as the volume of grain harvested or the level of demand.

The UK has just seen one of its poorest cereal harvests in many years; does this affect prices in the UK? To an extent, it does for two reasons: (1) the UK is likely to need to import a significant tonnage of feed wheat, which means the UK will sit at import parity price rather than export parity price (which is lower) and (2) local market variations occur due to strong local demand in individual regions. The first part of this, parity pricing, reflects the cost of shipping grain from regions of export to regions of import; the difference can be £15-20/t.

Figure 1 shows the daily value for the November 2026 London Wheat contract in £/t. The London market is based

on delivered-to-end-use pricing rather than ex-farm pricing, but for simplicity we will treat the ex-farm price as the same. This contract timing has shown variations in price from lows around £170/t during January/February 2026 to highs of nearly £220/t in late August 2026. AHDB reports forecast a UK average wheat yield of 6.9 t/ha from Harvest 2026; at this yield, the range in gross output from the variation in prices is a low of £1,173/ha to a high of £1,518/ha, a difference of £345/ha.

Yield variation

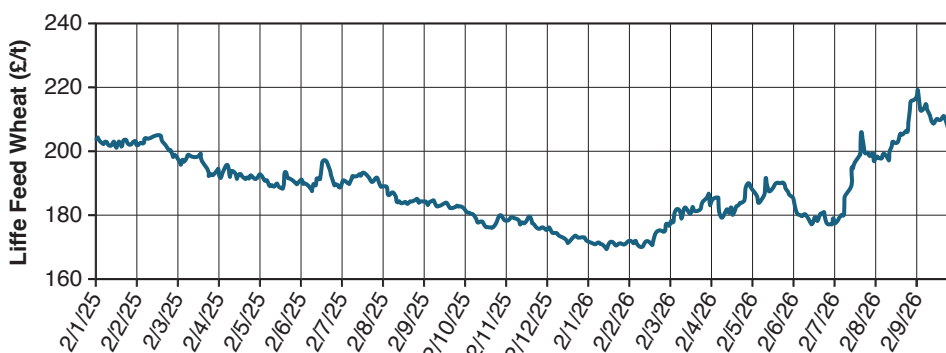
Whilst price is important, so is yield. Figure 2 shows the variation in annual average yield per hectare for wheat,

barley, oats and oilseed rape since 1984. One notable feature of this data is the increased variability in yields for all crops since 2012. In this relatively short period, we have had the highest yields ever for winter wheat (2015 and 2019) and two of the three lowest-yielding years since 1990. The range in annual average wheat yields for 1994-2009 was roughly 1.0 t/ha; in the 15 years since then, it has exceeded 2.0 t/ha.

This unpredictability causes instability in farm profitability, which can be accentuated by grain market volatility. At a wheat price of £200/t, this yield variation can see £200/ha added or removed from the profit of crops.

Figure 1. Daily price of November contract 2026 London Feed Wheat since January 2025

Source: AHDB Market Data accessed 1st Oct 2026



In oilseed rape, the annual variation of roughly ± 0.5 t/ha can be worth up to £250/ha up or down in the crop profit. These ranges of £400/ha in wheat and £500/ha in oilseed rape represent significant risk.

Why are these yield variations occurring? Principally, this relates to seasonal conditions, particularly autumn conditions for crop establishment, moisture levels in spring and early summer, radiation levels during grain fill, and increased high summer temperatures and heat stress affecting grain fill. None of these can be directly controlled by a grower, but there are risk management strategies that can help.

Input markets

The cost of growing an arable crop is made up of direct costs (e.g. seed, fertiliser and crop protection) and indirect costs that can be allocated to a crop, like labour, machinery costs and contractor costs. Direct costs like fertiliser are strongly affected by energy markets, as are fuel prices, the energy source for field operations. Much like grain prices, these are as much to do with global supply and demand as they are to do with geopolitics and war.

Figure 3 shows that the single greatest cost is nitrogen fertiliser, the price of which is linked to gas prices, as its manufacture is an energy-intensive process. The cost per hectare in Figure 3 is based on a nitrogen cost of £1.41/kg, which is equivalent to ammonium nitrate at £486/tonne, which is the high end of the market in recent months. Market movements during 2026 mean there have been prices ranging from £1.00/kgN to £1.40/kgN; in a typical UK wheat crop receiving 210 kgN/ha this means a cost per hectare range of £210-294/ha. On a typical UK wheat yield of 8.0 t/ha, this is a range of just over £10/t in the cost of production. The volatility in energy markets means that agricultural inflation is more a form of chaos than anything predictable.

A typical arable farm will use around 75 litres of fuel per hectare when growing winter cereal crops and oilseed rape. Figure 4 shows that increasing the fuel cost from a low of 65p per litre to recent prices of 115p per litre adds £37.50/ha to the cost of production; on a

UK wheat yield of 8.0 t/ha, this is £4.69/t to the cost of production.

Volatility in arable farming input costs, yields and grain prices is not a one-way path; volatility can create profit as fast as it can destroy it. With all the unpredictability, the removal of the Basic

Payment Scheme safety net and the less than satisfactory situation with the Sustainable Farming Incentive scheme, it becomes more important than ever to think about the best strategies for risk management in selling, in purchasing and in agronomy.

Figure 2. Annual average yields of major UK crops 1984-2025

Source: Defra, 2025

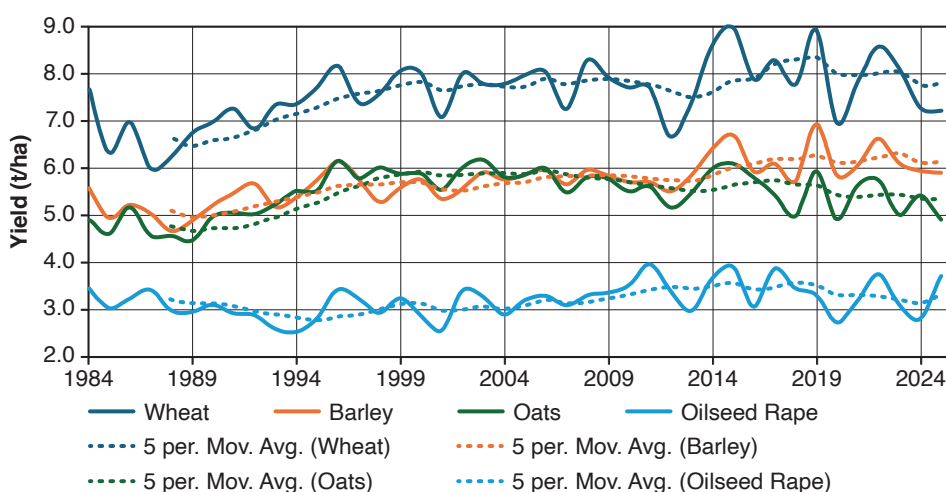


Figure 3. Typical direct costs of arable crop production (£/ha)

	Winter wheat	Winter barley	Oilseed rape
Seed	85	73	80
Nitrogen fertilisers	295	250	281
P & K fertilisers	120	120	120
Herbicides	85	65	85
Fungicides	112	55	20
Other crop protection	11	20	9
Total direct input costs	708	583	595

Figure 4. Diesel costs per hectare for winter cereals and oilseed rape at different price levels

Operation	Fuel (l/ha)	Cost at 65ppl (£/ha)	Cost at 115ppl (£/ha)
Primary cultivations	20	13.0	23.0
Secondary cultivations	10	6.5	11.5
Drilling	10	6.5	11.5
Rolling	2	1.3	2.3
Spraying x7	5	3.3	5.8
Fertiliser x3	3	2.0	3.5
Harvesting and haulage	25	16.3	28.8
Total (conventional)	75	48.8	86.3
Total (direct drilling)	50	32.5	57.5

Supporting trialling of new technology and practices on farm

Each issue of *Landmark* spotlights an ADOPT project in which Niab plays a key role. Each article will include a Q&A offering practical insights and perspectives. This instalment focuses on the role of biochar in improving nutrient efficiency and soil health.



Poppy de Pass • poppy.depass@niab.com



Poppy de Pass is Niab's regional agronomist for the west region, providing strategic agronomy consultancy to members and clients, interpreting technical information from trials and translating it into on-farm advice through group field days, seminars and conferences, publications, web material and digital communications. She has also worked in Niab's west area trials team.

Biochar: putting soil amendments to the farm test

With fertiliser costs, nutrient use efficiency and soil health a key consideration for cereal growers, interest is growing in products that could help farmers make better use of nutrients already present within the soil. This work forms part of an ADOPT-funded project, which Niab is part of, with lead grower Becci Berry steering the project. It investigates whether biochar could help reduce the requirement for artificial fertiliser in cereal production, while also improving soil condition and supporting crop establishment and performance.

The project is based on Becci's farm in Faringdon, Oxfordshire, and aims to understand how the material performs in a working farm system and what would be required to make its use practical on a larger scale. The initial work has focused on spring barley, given the project start date and biochar production, with further trials planned on winter wheat across both heavy and light soil types this season.

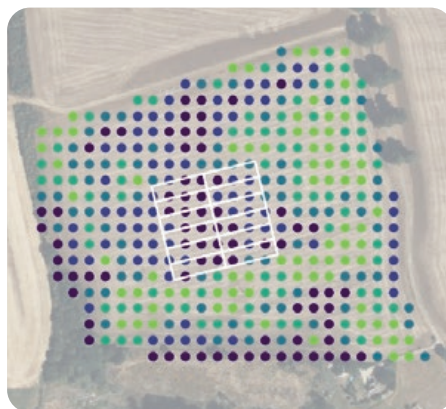
So, what is biochar? It is a form of charcoal produced by heating organic material in an environment with little or no oxygen. This process, known as pyrolysis, generally takes place at temperatures of 400°C or higher. The process produces energy-rich gases and liquids alongside the solid carbon material. That solid product is known as biochar and, in this stable carbon form, has attracted interest as a potential carbon sequestration tool.

However, biochar should not be viewed simply as another form of fertiliser. Its potential role is different. Its porous structure means it can act like a sponge, helping retain water

and nutrients in the soil. By improving conditions around the plant and helping retain nutrients, biochar may improve other efficiencies.

To locate the trials, soil samples were taken, alongside Niab's David Clarke using spatial information from previous yield data maps for the field, combined with satellite imagery, to place the trial in the optimum position for a fair result and distinguish the effect of a treatment from normal field variability (Figure 1).

Figure 1. Finding the optimum trial position using spatial information from previous yield maps



Production

A key part of the project has been developing the biochar itself. Project partner Tumblebug is producing the trial material using mushroom substrate, with the possibility of using other waste products in the future. Several batches and experiments were required to achieve a suitable consistency and pellet size for field application. When it came to applying the product, the group discussed several options, including a slug pelletter, but the rate and pellet size made this unviable; the same applied to an Avadex applicator. The pellet's texture and size meant it was likely to bridge and therefore not flow through a fertiliser spinner, so the group settled on using a lime spreader. Work then began with The Lime Company to ensure the product would spread evenly through their machines. One issue identified was the consistency of the product once activated with Atlantic Mariculture's liquid kelp, a biofertiliser (certified by the Soil Association) produced from sustainably farmed seaweed using zero-energy methods.

Figure 2. Biochar being spread by The Lime Company



The biochar was applied using an Agrisread AS85 with an even spread pattern to a rapidly drying seedbed in April as we entered what was to become a drought in Oxfordshire. The trial included a zero nitrogen plot as well as the farm standard of 120 kg N/ha. The remaining treatments had a base of 50 kg N/ha. The spring barley crop established successfully, but growth through the season was clearly affected by the weather conditions. Areas of the crop shaded by the tree line avoided extreme temperatures in the sunshine and had much thicker biomass.

Throughout the growing season, a microbiometre was used to assess the biological component of soil health across the different treatment programmes. This provides a rapid, in-field assessment of soil microbial biomass and the fungal-to-bacterial ratio. These biological indicators are relevant to soil health because microorganisms play an important role in organic matter decomposition, nutrient cycling and the development and maintenance of soil structure.

Following application, the trial experienced a prolonged period of limited rainfall. The resulting low soil moisture likely restricted microbial activity and reduced the potential for measurable treatment effects. Consequently, no consistent differences in microbial biomass or fungal ratio were identified between treatments. This result should be interpreted in the context of the environmental conditions experienced during the trial, rather than being taken as evidence that the treatments had no biological effect.

A measurable crop response was

observed under the farm nitrogen programme. The additional nitrogen treatment produced an approximately 20% increase in biomass compared with the base treatment, which received 50 kg N/ha when weighed at GS 39. This indicates that nitrogen availability remained an important factor influencing crop growth and biomass accumulation during the season.

By harvest, the crop had experienced significant heat and moisture stress. These conditions increased variability across plots, and the combine data were inconsistent between treatments. As a result, the harvested yield data did not provide enough confidence to draw conclusions about treatment effects on final yield.

This season, the intention is to repeat the work while also expanding the range of conditions under which biochar is assessed. The initial field is now drilled to winter oilseed rape, and the same assessments will be carried out in the field to see the effects in Season 2 since the biochar was applied. Season 2 also includes two new fields, in winter wheat, with biochar applications, representing both heavy and light soil types. This approach should help build a broader picture of how biochar behaves under different soil conditions.

Biochar may offer an opportunity to improve nutrient efficiency and make greater use of organic resources, but its place in commercial cereal production still needs to be established. The ADOPT project provides an opportunity to investigate those questions directly on a commercial farm. By testing the material in cereal crops, measuring its effect on soils and crops, and identifying the

machinery and handling requirements involved, Becci and the project partners hope to build a clearer picture of whether biochar can become a useful tool within a modern farming system. Results from the coming winter wheat trials and continued monitoring of the initial field should provide further pieces of the puzzle.

Figure 3. Grower Becci Berry in the field lab using the microbiometre



ADOPT 

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New international wheat hub to accelerate crop improvement

Niab is leading a major new international initiative to accelerate the development of higher-yielding, more resilient wheat. The three-year IWYP v2.0 – A Translational Hub for International Wheat Pre-breeding and Trait Validation project is funded by BBSRC and will build on the work of the International Wheat Yield Partnership (IWYP). Led by Niab's Dr Phil Howell, the project brings together Niab researchers, eight commercial breeding companies and international partners, including hubs at CIMMYT and Kansas State University.

The Cambridge-based hub will link research and commercial breeding by testing promising traits and genetic resources and helping translate scientific discoveries into useful breeding material. Niab's role builds on its long-standing expertise in wheat pre-breeding, genetics and field phenotyping, helping to identify and validate traits that can contribute to future improvements in yield, resilience and resource-use efficiency. The project began in October 2026 and will run for three years.



Scott Raffle recognised for contribution to UK horticulture

Niab's Scott Raffle has been awarded the Royal Horticultural Society's George Lockie Award for his outstanding contribution to horticulture and the UK fruit industry. Presented at Fruit Focus at East Malling in July 2026, the award recognises Scott's more than 30 years working in the fruit industry and his contribution to sharing research, innovation and practical knowledge with growers.

Scott joined Niab in 2022, bringing extensive experience from ADAS and the former HDC and AHDB, where he worked to disseminate research across the fruit and ornamental sectors. On receiving the award, Scott dedicated the recognition to the growers, researchers and colleagues who have shared their knowledge and experience with him throughout his career.

Welcome to Niab's new Chief Executive

Niab has welcomed Dr Katrina Hayter as its new Chief Executive, following her appointment in September.

Katrina joins Niab from HSBC, where she was Global Head of Sustainable Agriculture, Land Use & Food at the Group Sustainability Centre of Excellence. She brings experience spanning sustainable agriculture, finance, policy and commercial leadership, as well as an international perspective on the challenges facing food and farming.

She takes the organisation forward as Niab completes a period of significant change and begins its next phase of development. Katrina says her priorities include strengthening Niab's impact across crop improvement, independent testing and certification, and agricultural and horticultural systems – helping farmers and growers respond to challenges while taking advantage of new opportunities in science and technology.

"Niab is uniquely positioned at the intersection of science, innovation and practical farming," she said. "I look forward to working with Niab colleagues, partners and stakeholders to accelerate impact, strengthen resilience across the food system, and help deliver a productive and sustainable future for agriculture."



New approach to maize variety choice for 2027

The 2027 BSPB Forage Maize Descriptive Lists have been redesigned to give growers a clearer way to compare varieties and identify those suited to their farm and growing conditions. The previous classification of varieties as favourable, very favourable, and less favourable sites has been replaced by four Lists: Short-Mid Season – First Choice; Short-Mid Season – Second Choice; Mid-Long Season – First Choice; and Mid-Long Season – Second Choice.

The new approach reflects increasingly variable growing conditions and the difficulty of predicting variety performance from a site's classification. Instead, results are assessed across the full network of 13 independent BSPB trials, providing a broader picture of performance across UK conditions. Ten new varieties have been added for 2027, while the latest results continue to demonstrate long-term improvements in maize performance. Over the past decade, dry matter yields in BSPB trials have increased by more than 2 t/ha, alongside improvements in starch and energy content.

The Lists are managed by Niab on behalf of the BSPB.





Dr Nichola Hawkins is a research scientist at NIAB, based in Cambridge, working on fungicide resistance. Antibiotic resistance is a well-known problem in healthcare but similar problems are seen in agriculture, with resistance to the fungicides, herbicides and insecticides that are used to protect our crops.

From decomposing underpants to decoding DNA: new ways to measure fungi in soil and air

Fungi are all around us, with an estimated two to three million species worldwide. Your first thought might be of mushrooms and toadstools, but they range from the single-celled yeast used to make bread or beer to underground networks of fibrous mycelium spanning hundreds of hectares. Any healthy soil contains thread-like fungal hyphae, and every breath of air contains microscopic fungal spores. Some can cause destructive plant diseases, whilst others are vital for soil health. Understanding which fungi are present, and how their populations change, could help us better understand disease risk, soil health and the development of fungicide resistance.

Some of the most damaging plant diseases include rusts, which grow on living plants and are spread by airborne spores. Septoria grows in wheat leaves and spreads within a crop by rain splash, but later in the season it also produces airborne spores that can travel long distances to infect new crops. Bunts and smuts are seedborne, while

diseases like Rhizoctonia and Take-all are soilborne. Soils can also harbour the mould *Aspergillus fumigatus*, which can cause serious infections in people with weakened immune systems. These infections are treated with antifungal drugs, primarily azoles; they share the same mode of action as the azole fungicides used on crops, raising concerns that agricultural use of these

fungicides can select for resistance to medical antifungal drugs.

Other fungi benefit agriculture, playing roles in healthy soils and supporting healthy plants. Fungi and bacteria break down crop residues and other dead plant material, making nitrogen and other nutrients available for subsequent crops. Fungi produce enzymes that help to mobilise phosphorus and other minerals within the soil. They help form humus, soil organic matter that supports soil structure and carbon storage. Some fungi benefit plants more directly, including mycorrhizae that help roots take up nutrients, while others can suppress plant pathogens or promote plant immunity.

A simple way to look at soil health is the “Soil your undies” test, which involves burying a pair of cotton underpants and seeing how quickly they decompose. This gives an overall measure of soil microbial activity in breaking down organic material, but cannot tell us which microbes are responsible.

NIAB is working with partners at Imperial College London, the UK Centre for Ecology and Hydrology, and the Open University to develop methods that can give a more precise and detailed picture of the fungi present in the soil and air, and what this means for soil and plant health. The project is looking at fungi in soil, air and compost, on farms and in homes, gardens and composting



facilities. Farmers and other volunteers received sampling kits and used several approaches to measure fungi. Cotton strips provided a more precise version of the underpants test, enabling us to accurately measure the decomposition of identical pieces of fabric across different settings.

Participants were also asked to fill a small tube with soil for metagenomic analysis: sequencing the DNA mixture from all organisms present and matching it to database sequences to identify them. To sample fungal spores in the air, a simple sampling device containing sheets of sticky film was hung up. Two different methods were used to analyse the fungal spores caught on the sticky traps. Strips of the film were used for DNA extraction and metagenomics, as with the soil samples. Next, the remaining films were placed in Petri dishes with specialised agar to grow any *Aspergillus* present and test azole resistance levels.

So far, these methods can identify fungi in soil and air and group them into broad categories, including decomposers and plant pathogens.

As more samples are analysed, we will compare how fungal spore production changes through the seasons, assess the effects of different crops and management practices, and determine how closely the cotton strip decomposition rate corresponds with levels of different fungi.

The research will also identify hotspots for the development of azole-resistant *Aspergillus* moulds, so that actions to manage resistance can be targeted where they are likely to have

the greatest impact while keeping azoles available for crop protection where needed. By building a fuller picture of the fungi present, we can better understand the interactions between damaging and beneficial fungi, crops and soils. This could help us understand how cropping systems and management practices influence disease risk, soil health, and the development of fungicide resistance, and where management changes could have the greatest benefit.

One Health in practice

This research forms part of a wider One Health agenda, recognising the links between plant, environmental, animal and human health. Niab is contributing through both research and stakeholder engagement across the supply chain. Recent activities have included a dedicated One Health seminar at Groundswell 2026 with Professor Mat Fisher, Dr Ed Bailey from Vet Sustain, and farmer and Niab Agronomy Member David Passmore, our researchers have presented agricultural insights at One Health-focused events, and outreach activities at open days where we have brought topics such as antimicrobial resistance, fungal ecology and sustainable use of pesticides directly to farmers and growers across England. Together, these activities help bridge the gap between cutting-edge research and practical understanding of how agricultural systems interact with wider environmental and public health challenges.



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The future of maize production in the UK

Historically, insufficient heat accumulation, short growing seasons, and slow crop maturation have constrained maize production in the UK, particularly in northern and western regions. Maize is fundamentally a warm-season crop, and many areas of the UK have traditionally struggled to accumulate enough thermal units to mature crops reliably before autumn.

Climate change is gradually removing many of these limitations. Warmer summers and longer growing seasons, along with improved genetics and earlier-maturing varieties such as those listed on the BSPB Forage Maize Descriptive List, are allowing maize production to expand in regions previously considered marginal. Areas regarded as marginal for maize production now regularly achieve sufficient heat accumulations, creating opportunities not only for forage maize but increasingly for grain maize production with a wide range of end uses.

The total UK maize area is about 250,000 ha; forage maize is now over 150,000 ha, AD/biogas maize is up to 80,000 ha, and grain maize is over 20,000 ha. This growth is being driven by the use of maize as a break crop, supported by

expanding anaerobic digestion markets and faster-maturing varieties that allow more reliable crops further north where the risk of soil water deficits is lower.

The 2026 growing season has illustrated both the opportunities and challenges that climate change presents for UK maize production. Across much of England, crops established well during favourable spring conditions and benefited from rapid early growth driven by above-average temperatures. In many regions, thermal time accumulation was ahead of the long-term average by early summer, supporting strong crop development and accelerating progress towards maturity.

However, while some areas recorded excellent growth and yield potential, high heat and lack of rainfall led to periods of prolonged moisture deficit during key stages of crop development such as tasselling and grain filling, with many crop failures. Differences in soil type, rooting depth and water-holding capacity became increasingly apparent as summer progressed. Crops growing on deeper, moisture-retentive soils maintained canopy growth and green leaf area, while those on lighter land showed signs of stress during dry periods.

The contrast seen in 2026 reflects a broader trend likely to shape the future of maize production in the UK. However, the benefits of warmer conditions come with significant challenges. Increasing weather variability and more frequent extremes are creating new production risks. Future success will depend on the ability of soils, crop genetics and farm management systems to cope with cold

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 to develop research and training projects and contributes to Niab's agronomy guides and publications.

springs and dry summers. Inadequate water availability is likely to become the dominant yield-limiting factor across many regions.

This shift is already evident in several continental European maize-growing areas, where average yields have continued to improve, but yield stability has declined as drought risk and weather volatility increase. UK maize production, particularly in the south-east, is likely to follow a similar pattern.

As temperatures rise, maize increases evapotranspiration, with higher atmospheric vapour pressure deficits and greater overall water demand leading to substantial moisture deficits during critical growth stages such as tasselling and grain fill.

Several interacting factors will strongly influence future maize performance across the UK: soil water-holding capacity; summer rainfall distribution; drought frequency and intensity; effective rooting depth; soil organic matter content; and access to irrigation.

As a result, soil management is now as important as variety selection. Improving soil organic matter, enhancing soil structure and increasing rooting depth will all play critical roles in helping crops access water during dry periods.

Regional outlook

Eastern England is likely to remain one of the UK's highest-yielding maize-producing regions. The area already accumulates substantial maize heat units and is becoming increasingly suited to



later-maturing, higher-yielding forage hybrids and grain maize production. However, the region also faces some of the greatest climate-related risks. Predicted reductions in summer rainfall and increasing moisture deficits are expected to make drought the principal constraint to production.

The south-west has traditionally been one of the UK's most reliable maize-growing regions due to favourable rainfall patterns, longer growing seasons and relatively mild autumn conditions. Climate change is unlikely to alter this fundamental advantage. Nevertheless, increasing winter rainfall and more frequent extreme precipitation events create significant challenges, including difficult harvesting conditions, increased soil damage, erosion, and nutrient loss. As environmental regulation continues to focus on protecting water quality, the industry will likely place increasing emphasis on management systems that reduce soil movement and improve soil resilience, such as undersowing, reduced tillage and traffic management.

The Midlands may emerge as one of the most balanced regions for maize production under future climate scenarios. As plant breeding continues to improve drought tolerance and stress resilience, this region could deliver some of the UK's most consistent maize yields. Warmer temperatures are improving crop reliability, while rainfall levels generally remain higher than in south and east England.

Northern England could experience some of the greatest benefits from climate change, with many northern regions retaining a relative advantage in rainfall availability. The shorter growing season is likely to support good yields for earlier-maturing varieties.

Scotland is expected to remain a challenging environment for maize production, although opportunities are increasing. Very early-maturing varieties can already perform well in parts of southern Scotland, and future warming is likely to expand these opportunities further. However, significant limitations remain, including lower levels of solar radiation and challenging harvest conditions.

Breeding for a new climate

Climate change is likely to increase overall maize production potential across much of the UK. Warmer temperatures, longer growing seasons, and increasing thermal accumulation are opening opportunities in regions previously unsuitable for the crop. Plant breeding will play a central role in helping maize production adapt to future climatic conditions. Ideal maize varieties will combine high productivity with resilience to multiple environmental stresses.

Key breeding objectives include strong drought tolerance, deep, efficient rooting systems, improved nitrogen-use efficiency, vigorous early growth in cool spring conditions, improved heat tolerance, stay-green characteristics



during summer drought periods, and stable performance across variable environments.

The most significant challenge will likely become water management. While average yields may continue to rise, consistent yields year after year will increasingly depend on soil health, water retention, crop rooting characteristics, and climate-resilient genetics. Maintaining productivity during periods of water stress will become increasingly important as weather variability intensifies.

As climate change continues to reshape UK agriculture, the most resilient maize systems will combine improved genetics with management practices that conserve water, protect soils, and withstand increasingly variable weather.



A guide to undersowing maize

Niab, in collaboration with Anglian Water and the Maize Growers Association, has developed an undersowing decision support guide and interactive tool.



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In this issue, *Landmark* gives Niab PhD student Alexander Owens an opportunity to introduce himself and summarise his research.

Alexander Owens

The sustainable management of lowland peat in the Cambridgeshire Fens.
BBSRC-funded CTP-SAI with the University of Nottingham and Sainsbury's.
October 2024 to October 2028.



My research centres on peatland conservation in The Fens region of the East of England, helping to determine where peat remains, how much has been lost over time, and how best to target conservation resources to support evidence-based decision-making. Thousands of data points from soil surveys and boreholes are being used, including survey points from the 1981 Lowland Peat Survey of England and Wales, written and typed borehole logs from the British Geological Survey which was scanned digitally, and survey data from Natural England, alongside peat depth data donated by partners and colleagues and data collected during the project fieldwork.

To assess changes in peat depth over time, a gouge and Russian auger were used to probe peat thickness and collect samples. Soil samples were taken from the surface, using a small metal ring, and all the way to the bottom of the peat profile using a Russian Auger. These samples will be analysed for carbon content, and to determine whether it can still be called peat.

Measurements have been taken across The Fens, from large-scale farms to conservation Sites of Special Scientific Interest. While most places appear to have lost peat, some sites, such as in the Nene Washes, have

registered small increases of peat which is great news for conservation.

I also worked alongside Niab and Bangor University in delivering a project on the possibility of removing English lowland peat from farming altogether, which included modelling peat loss throughout time, climate change scenario crop modelling and soil emissions estimates.

However, knowing where the peat is located is not enough. We want to know how fast it is being lost and from where, which can help us better understand conservation in the future. For this, inSAR satellite data is used, which measures surface movement. To calibrate the satellite data, small subsidence rods are being installed across the landscape in peat soils, from farms to nature reserves, and analysis of the satellite images will begin in late October. There may be a future opportunity to work with the satellite company TerraMotion to calibrate their data with the inSAR and soil data to produce a high-resolution subsidence map of the region.

Sainsbury's are the industrial partner in my PhD, connecting this research to supply chain requirements, my interaction here will allow me to learn more about how production links to retail. And then the final objective of the research is to develop a Peat Soil Decision Management tool to help landowners and farmers best manage their peat for years to come.



Nene washes, November - depth approximately 180 cm





Dr Graham Dow is a group leader in ecophysiology and climate adaptation. His research is focused on understanding mechanisms that facilitate plant-environment interactions and increase crop resilience to climate change.

Detecting early signals of tree stress

Research interests are increasingly focused on developing technologies that can detect early signs of plant stress in various crops. Traditionally, plant stress caused by water and nutrient deficiency or pest and disease attack has been detected by visual crop inspection. Often, by the time interventions correct the problem, short-term stress has already caused some yield penalty. Developing technology that detects plant stress at earlier stages would allow crop management changes to be implemented quickly and reduce yield penalties. To date, very little research has been carried out to develop early warnings of stress in woody tree fruit crops.

Niab has been working under a Swiss – UK bilateral R&D programme funded by Innosuisse and Innovate UK. The UK consortium is led by Benchmark Control Ltd and the Swiss consortium by Vivent Biosignals, with the goal of developing sensors that record tree electrophysiology and indicate stress before visible symptoms appear (Figure 1). Niab's research contribution has been carried out in a Gala apple orchard grown by consortium partner Adrian Scripps Ltd. The sensor hardware produced by Benchmark and Vivent is about the size of a deck of cards, with a transmitting device at the top and miniature environmental sensors at the bottom (Figure 2). Two electrodes from the device are inserted directly into the tree, one into the branch vascular system (Figure 3) and the second into the main trunk. The device measures the electrical difference between electrode locations in real time, and machine learning algorithms interpret these electrical signals as changes in biological activity. The resulting data is sent to a centralised 5G router in the orchard, which transmits data via the cellular network, allowing information to be continually relayed to a farm manager's computer.

In this project, a trial was set up in 2025 to impose different levels of water stress on Gala apple trees and compare electrophysiological sensor output with traditional ground-truth measurements of plant water stress. If the sensors correlate with the other measurement approaches,

Figure 1. Next generation electrophysiological sensor being set up in an orchard



Figure 2. The hardware erected in the tree



it will provide confidence that the electrophysiological data can accurately measure water stress without relying on more time-consuming, labour-dependent measurements.

Within the trial Gala orchard, sensors were set up in four different plots. Two plots were positioned at the north end of the orchard, where sandy soils are fast-draining, and two plots at the south end, where clay soils are slow-draining. In each plot, water stress was imposed during July and August by withholding drip irrigation in one 'treatment' row and maintaining irrigation in one 'control' row. This combination of soil type and irrigation input created four experimental groups to analyse.

The Niab research team wanted to determine if the data collected from the electrophysiological sensors would correlate with three different ground-truth measurements of plant water relations: stomatal conductance (a measure of leaf transpiration); stem water potential (a measure of water stress); and soil matric potential (a measure of soil water availability). Ground-truth measurements were taken once or twice weekly from June through to September, while electrophysiological data was produced on a continual daily basis throughout the season.

In July 2025, when the first irrigation treatment was imposed, wet and cool weather conditions prevented the development of water stress, and data from the ground-truth measurements were similar across the four groups. In August, hotter and drier weather conditions started to impose water stress across the groups, and differences were recorded in the ground-truth measurements. During this period, data from the electrophysiological sensors significantly correlated with both stomatal conductance and soil matric potential. Surprisingly, stem water potential showed no correlation with the electrophysiological data. Stem water potential is often considered the first indicator of plant water stress, highlighting the need to better understand the timescale(s) at which electrophysiological data can indicate water stress.

These results show encouraging progress: electrophysiological sensors can deliver useful measurements of water stress in real-time and without labour-intensive approaches. With additional refinement, electrophysiological sensors can hopefully be deployed in an orchard-wide layout for automated irrigation based on tree water status, where

irrigation is actuated when the sensors indicate water stress is dropping below a predetermined level, say 50%. In effect, the sensors provide a system in which the tree tells producers when it needs water, rather than relying on proxies derived from soil moisture levels or environmental conditions.

In the future, Vivent plans to use the technology to measure other parameters, such as nutritional content (N, P, K, Mn, Ca), to identify when the tree is experiencing nutrient deficiencies. The digital dashboard provided to producers, which relays sensor information, is also being integrated with existing agronomic and forecasting tools, such as Omnia Digital Farming, led by project partner Hutchinsons.

This project has successfully demonstrated an automated stress detection system that uses reliable sensor hardware and communication software for continuous, real-time assessment of plant electrophysiology in orchard systems. We validated a model that predicts water status and plant health from electrophysiology data using ground-truth plant physiology measurements. There is now potential to exploit this system in digital farming system management.

Figure 3. Sensors are inserted in the branch vascular system





Reintroducing the English Elm through tissue culture

Woodlands in the UK are an incredible source of biodiversity, providing complex habitats for native plant and animal species and allowing these sanctuaries to thrive. Elm trees are an important pillar of this ecosystem but have faced growing threats that put their survival at risk. Dutch Elm Disease is a major cause of elm decline in our British countryside. An estimated 25 million elms have died in Britain since the disease first appeared in the 1970s, with a devastating change in the landscape seen today.

Two amateur enthusiasts and friends, Dr David Herling and Fergus Poncia, addressed this problem in the late 2010s by producing hybrid elms through conventional crossing of highly resistant material with surviving British material. They then assessed these genetically different seedlings for resistance to Dutch Elm Disease.

Unfortunately, conventional propagation of hybrid elms is strongly genotype-dependent and affected by physiological age, seasonal condition, rooting competence and the maturation state of the source material. Following David Herling's death in 2020, his work and legacy continued through people

dedicated to bringing elms back into the British landscape, but the limitations to this approach remained.

So alternative propagation techniques were investigated, and the Niab micropropagation team was asked to propagate the final four resistant candidates. Using tissue culture techniques, we have successfully propagated and maintained a resource of these genetically resistant hybrid elms. They have been multiplied through initiation, via excision of the meristem from woody cuttings in the spring, through to in vitro multiplication, rooting and acclimatisation.

Wallmead Farm Elm Nursery has since distributed the young, strong elm trees produced at Niab to Kent County Council, South Downs National Park, Hampshire County Council, the Duchy of Cornwall, the National Trust, and individual landowners throughout the UK.

The tissue culture laboratory at Niab is proud to have helped preserve this valuable disease-resistant trait whilst supporting the work of others who have spent years trying to secure a future for species such as elm.

What started as the tiniest piece of plant material from a shoot in our tissue culture laboratory will one day become a

Kirsty leads Niab's high-health tissue culture facility and has over 30 years' experience in applied crop research, plant breeding, pathology and tissue culture. She has extensive expertise in fruit breeding, disease resistance screening, micropropagation and high-health plant production.

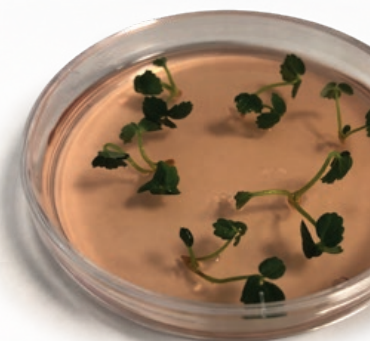


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Q Case Study:

Tissue culture plants, provided by Niab's tissue culture laboratory, have become indispensable for an international raspberry and blackberry breeding programme based in the UK.

Good quality in vitro plants are often used to clean up germplasm stock; nowadays they are essential to transport new advanced selections for trial and propagation in continental Europe. Raspberries in particular are famously difficult to establish in culture and protocols often need to be modified to suit reluctant varieties.

Niab continues to optimise its methodology to ensure good culture establishment of both germplasm collections and new varieties.





Dr Francis Wamonje is an entomology research leader who specialises in molecular and applied entomology and has expertise in pest detection, surveillance, and biocontrol strategies. He leads research projects to improve agricultural sustainability and environmental resilience.

Genetic identification of thrips made easy

It is particularly difficult to distinguish between thrips species, and the only way growers and agronomists can be confident they are accurately identifying those found in their crops is by seeking help from trained, experienced entomologists. They use microscopic techniques that are time-consuming and expensive for growers, and by the time they make a correct identification, crop damage may have occurred. A much faster and easier technique is needed.

Thrips species have been a major pest of strawberry crops in the UK for thirty years. Initially, high numbers of certain species feeding on flowers were associated with some level of fruit damage, caused by larvae and adults feeding in the flowers (Figure 1). The non-native species *Frankliniella occidentalis* (western flower thrips – WFT) arrived in the UK in the 1980s but was not found to be causing damage to strawberry until 2002, when it developed resistance to a number of control products, most notably Tracer (a.i. spinosad). WFT causes serious damage to strawberry, leading to a brown or bronzed appearance on the fruits,

which very often fail to develop to their full size. With the help of research and agronomists, many growers developed successful biocontrol programmes for WFT (Figure 2), but other species continued to be found on strawberry, and it is difficult for growers and agronomists to identify which species are present in their crop.

Other species typically found in strawberry include onion thrips (*Thrips tabaci*), rose thrips (*Thrips fuscipennis*) and flower thrips (*Frankliniella intonsa*). Because these species require different management and control approaches, it is vital to know which species is in the crop, but accurate identification is

difficult due to the small size of thrips and subtle variations between species. Niab entomologists at East Malling have the skill to make such identification, but this requires slow microscopy work. A much quicker, simpler method is needed.

This Innovate UK-funded project aims to create a user-friendly, rapid in-field test for WFT that would enable growers and agronomists to make informed pest management decisions without requiring specialised entomology skills. If Niab develops a successful test, we will work with industry collaborators to create similar detection tools for a range of other native and non-native thrips species, including those commonly found in strawberry.

Figure 1. Thrips feeding in a strawberry flower



Figure 2. Growers rely on *Neoseiulus cucumeris* to control WFT



Throughout the project, the team has sampled thrips in commercial strawberry crops to survey the prevalence of different species typically found. In the first year, the populations identified were largely made up of WFT, onion thrips and rose thrips, with virtually no flower thrips. In the second year of surveillance, populations of flower thrips were more prevalent along with the other three species.

Early work focused on identifying genes and gene sequences that could serve as markers to identify WFT. Primers were developed to find these markers within an organism's DNA and are used to develop test kits that might be used

in the field. After developing a primer specific to WFT, the work expanded to identifying genetic markers and producing primers for onion thrips, rose thrips, and flower thrips. This was successfully achieved, so that we can now identify all four thrips species using molecular marker technology.

The next stage of the work was to find a practical way of collecting the DNA from the different thrips in the field. Asking growers or agronomists to collect samples of every thrips species that might be present in the field and submit them is impractical and risks missing species present in the crop. Niab instead chose to develop a way to collect

environmental DNA from the crop. Environmental DNA (eDNA) consists of traces of genetic material that all living organisms leave in the environment; in the case of strawberries, a visit from any thrips species to a flower in the crop would leave a trace of its genetic material behind.

Different methods were trialled, including generating flower washes to harvest the genetic material contained within the flowers and direct extraction from fresh and dry flowers, with the latter proving most efficient. Growers or agronomists would collect 20 strawberry flowers from a cross section of the crop and send them to the entomology team, who would capture genetic material from visiting thrips, which is then identified using the primers developed for each thrips species. The team will develop a full protocol with guidance for growers and agronomists on how to collect flower samples (Figure 3) for the test.

The end goal is to develop a practical test kit that would allow growers to sample flowers and identify thrips species themselves, without having to submit samples to Niab, or alternatively, work with an agronomy provider to do periodic assessments as part of routine monitoring. Niab is currently talking to commercial technology providers who might work with us to develop this final step in the process.

Figure 3. Thrips DNA can now be extracted from strawberry flowers





Asia Roberts-Yalland is a laboratory manager at the OSTs and has been a fully qualified seed analyst for over five years. As a member of the ISTA technical committee for tetrazolium, she also helps develop, standardise, and validate methods associated with tetrazolium testing.

The race to test seed quality

Tetrazolium testing can assess cereal seed viability and vigour within 24 hours. But the test has a fascinating history, shaped by scientific rivalry, controversy and decades of method development.

2026 has been a particularly early cereal harvest, with dry ground extending the time between harvest and autumn sowing in some areas. However, the window for autumn sowing of winter cereals is, generally, relatively narrow, with sowing often occurring soon after harvest. The topographical tetrazolium (TZ) test can be particularly useful in this window, quickly providing essential information about seed performance potential and informing decisions. Niab's Analytical Services team performs hundreds of tetrazolium viability tests every year, the majority of which also request an estimation of vigour.

The TZ test exploits the enzymatic reactions that occur during seed respiration. The colourless 2,3,5-triphenyl tetrazolium chloride salt (TTC) enters the living cells of the seed embryo and undergoes a reduction reaction that converts the TTC into the red-coloured substance, formazan, which cannot diffuse out of the cells, leaving a red stain. The extent of staining can then be evaluated by a qualified analyst who will make an assessment of viability, and with extensive experience, can go further, examining staining intensity and patterns to estimate seed vigour.

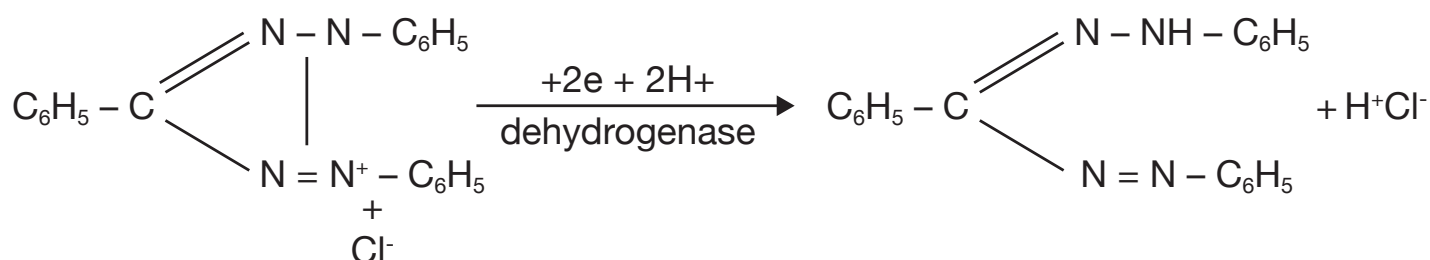
The narrow autumn sowing window is not just an issue in contemporary farming; over the 19th and 20th



centuries, attempts were made to develop a 'quick test' to determine seed viability as an alternative to a standard germination test; in fact, the race to provide a solution brought significant scientific rivalry and controversy. Between

1925 and 1935, researchers in Russia, Germany, and Japan competed to be the first to succeed with a 'vital staining' test using selenium and tellurium salts.

The Japanese scientist Hasegawa had spent years researching a quick



Colourless & diffusible – 2,3,5-triphenyl tetrazolium chloride **Red & non-diffusible** – Triphenylformazan

stain test for tree seeds (which have a comparatively long germination time), but his work was largely unknown to European seed scientists because he published it in Japanese. In 1931, he travelled to Germany and was persuaded to disclose his discoveries; a plagiarism row ensued over the method's origin and best practice. Following the death of one researcher, the dismissal of another, and the bombing of Hasegawa's laboratory during the war, it was the prominent German botanist and seed researcher Dr Georg Lakon who ultimately came out on top.

Lakon initially developed the topographical selenium method,

going further than previous methods by looking at the extent and types of staining. Selenium and tellurium compounds had long been known to be poisonous, and attempts had been made to find a non-toxic alternative. Russian scientists even investigated beet and flower petal juices. Again, Lakon discovered the solution: 2,3,5-triphenyl Tetrazolium chloride was a safe option that provided accurate results.

Over time, the use of TZ has grown in popularity and developed into the test used today, which is standardised by the International Seed Testing Association (ISTA). In 1956, the first ISTA Tetrazolium Committee was appointed, cementing the test's future by creating a uniform,

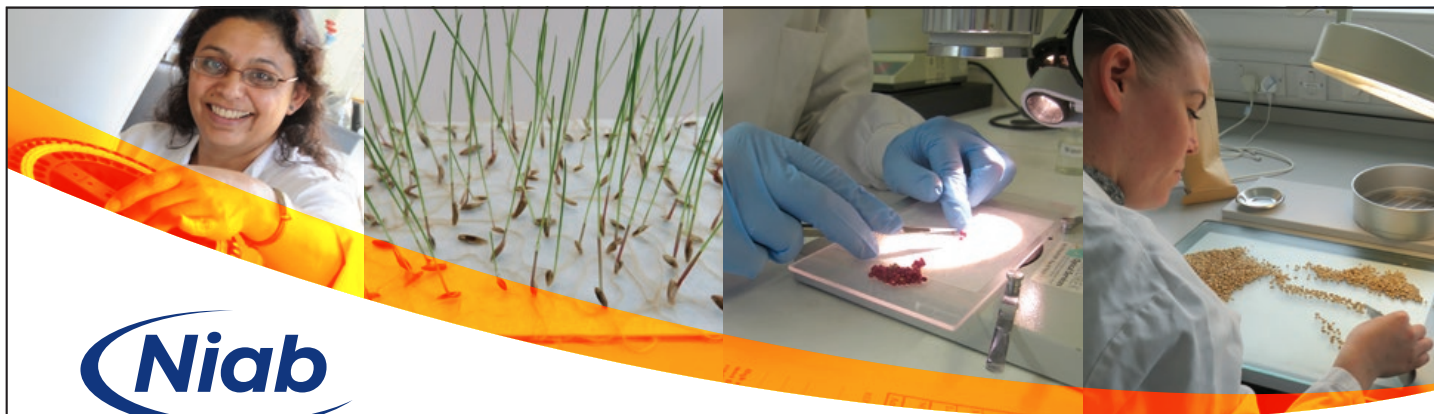
accessible, internationally recognised method.

The Niab seed testing laboratory has been conducting a Tetrazolium viability test for decades, even patenting an in-house method in 1983, shortly after applying principles of vigour testing to develop an internal TZ Vigour test. Today, we continue to contribute to the advancement of TZ testing with a member on the ISTA Tetrazolium committee, contributing to the publication of the updated ISTA Tetrazolium handbook, and participating in method validation studies, most recently for soybean (*Glycine max*), which is to be added to the ISTA rules in 2027.



Barley seeds showing different staining levels





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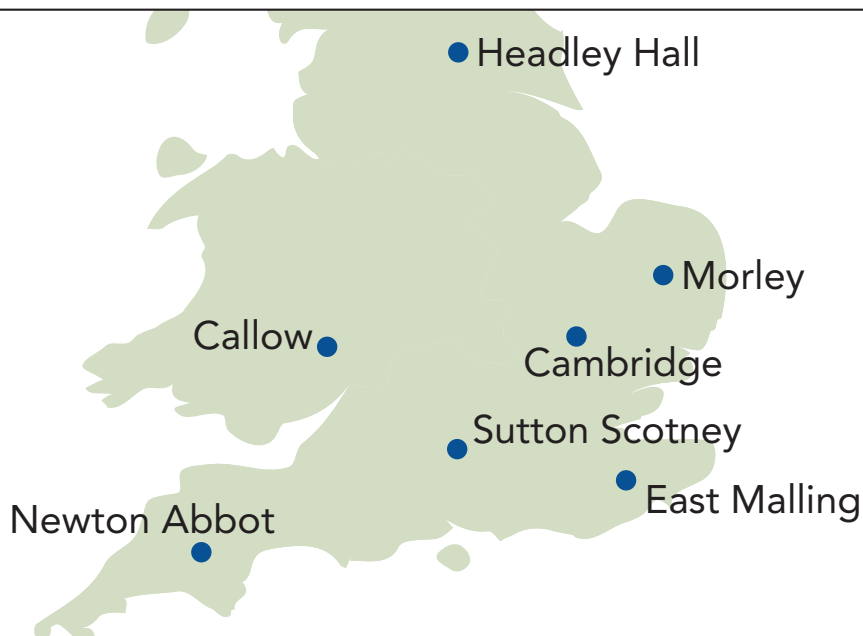


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