

The outer reaches of on-farm innovation



Farmer-led research

A landrace wheat, never grown before in the UK, may provide the route to slug-resistant wheat. CPM visits a specialist farming company taking part in the quest and reports first-year results of the farmer-led trials.

By Tom Allen-Stevens

In the bright, early spring sunshine, the pale green of the Watkins 788 landrace wheat sits in striking contrast to the darker green of the Gleam winter wheat that surrounds it.

Jamie Melrose stoops to inspect a few plants. “Right from establishment it’s looked well, but the Watkins really is motoring on now. If it wasn’t for its bright green hue, you’d barely be able to distinguish it from the Gleam. That makes these two wheats quite different from the Blackman wheat, even though both the Blackman and the Watkins were drilled at the same seed rate — 60% of what we used for the Gleam.”

He gestures to the next-door tramline. Occupying its width are two square plots of

a third wheat, this one bred by independent UK plant breeder John Blackman — a pre-commercial line of KWS Santiago x Graham. It looks to be a pace behind the Watkins, which similarly takes up two 36x36m plots within the field.

But it’s not their growth rate that’s of interest. Both these unusual wheats may be resistant to slugs. For the Watkins 788, this came about through a public-funded study of the landrace variety that came from central Asia almost 100 years ago (see panel on pxx).

Slug sleuths

It’s part of a farmer-led trial co-ordinated by BOFIN (British On-Farm Innovation Network). Ten “Slug Sleuths” — farmer members of the network — are growing plots of Watkins 788 and comparing it with their farm standard. All of the plots were carefully monitored for slug activity and grazing damage by the farmers during establishment last autumn.

The Blackman wheat has a very different story that’s brought it to this field near Hitchin in Hertfordshire, farmed by AT Bone & Sons. The line was one of 30 pre-NL1 multiplications established in autumn 2021 by John on alluvial, heavy boulder clay near Cambridge. Nearly all the lines were obliterated by slugs, with just this one appearing relatively unscathed. That left just enough seed for four of the Sleuths to put it to the test, alongside the Watkins.

Jamie wanders over to one of the 12 slug ▶

“The trial has opened our eyes to a multitude of ways we can reduce the impact of slugs.”



A yearning to explore the outer reaches of research and innovation prompted Andrew Francis to set up TEAM Ag.

Farmer-led research



The Gleam (left) looks on a par with the Watkins 788 (centre), despite being drilled at a lower seed rate, with the Blackman wheat (right) some way behind.

► refuge traps he's placed within the plots and inspects it for activity. "None here, and it's been the same since we established this crop last autumn — I've barely seen a single shredded leaf," he reports. "That's unusual, because we specifically chose this site, in a crop following oilseed rape, because it's a haven for slugs. But I don't think their absence is down to the wheat varieties we've established."

Previously farm manager for AT Bone,

Jamie has now joined TEAM Ag (UK). The acronym stands for Transformational Estate and Agricultural Management and the company was set up by Andrew Francis late last year, with partners Kiryon Skippen and Jason Noy, to supply specialist services to UK estates and farms.

On-farm trials are one of those services, and Andrew brings into it 30 years' experience from his previous role as farms director of the Elveden Estate, a 9500ha

farming business based near Thetford in Norfolk.

"At Elveden, we constantly asked ourselves how we could do things differently. Typically we'd take standard farm practice, double it, halve it and explore the outer reaches," says Andrew.

Increasingly Elveden built a reputation for cutting-edge field-based research, becoming a Strategic Potato (SPot) farm as part of AHDB's Farm Excellence network, as

Farmers prove the science of on-farm trials

The first year of the farmer-led trials have been hailed a success for science. But record low slug populations last autumn have meant results are inconclusive.

The trial is part of a study, co-ordinated by BOFIN, to help farmers move away from a reliance on chemical control measures and the potential environmental impact of those chemicals.

It's the first time this type of study has been undertaken in the UK and the 10 farms involved are spread across England, from Cambridgeshire to Devon, Oxfordshire to North Yorkshire. The Slug Sleuths followed a protocol developed by BOFIN with Keith Walters, Professor of invertebrate and pest management at Harper Adams University, who also analysed the results. "The farmers did a first-rate job," he comments.

Field trials are an essential element when testing new techniques and technologies, he points out, so the fact that farmers can set up

and deliver results "to the standard of professional trials technicians" is significant.

"The implications are huge — if we can get scientifically sound results from a range of sites without sending research assistants all over the UK, that offers significant savings for field research."

However, the hot summer and dry autumn conditions confounded conclusions that could be drawn. Very few slugs appeared at establishment or soon after, when crops are at their most vulnerable to damage, and none of the wheat across the plots suffered significant damage.

"I've never known a year like it — it was good news for farmers, but sadly we're no closer to knowing whether this wheat does have a slug-resistant trait."

Keith explains that the 10 sites were selected specifically because they were high-risk for slugs — all first wheat after OSR in a field known to be problematic (see diagram on pxx).

"Previous research has shown this to be the right size of plot and distribution of traps to adequately monitor slug feeding behaviour. Ideally we would have liked more replication at each site, but the intention of the trial was as much about whether farmer-led trials would yield appropriate data, as the impact of the wheat lines on slug damage," he notes.

"But there simply weren't enough slugs at any of the sites. Years of studies with refuge traps have shown you need at least 1.2 slugs on average per trap to reach a valid conclusion about any difference between treatments. The most we had in this trial was 1.07/trap, the next highest



The 10 "Slug Sleuths" have been credited with delivering the trial to the standard expected from professional trials technicians.

was 0.46/trap, and one of the Sleuths recorded no slugs at all in traps."

Plenty of beetles were found in the plots, however, which has spurred the Sleuths on to find out more about their value as slug predators and how to encourage them in the field. Valuable lessons were also learned about monitoring methodology, such as use of photographs to eliminate errors between sites due to subjective scoring.

The monitoring also showed Watkins 788 generally emerged later and slower than the farm-standard variety. The very latest observations from the plots this spring show that the landrace variety has caught up with its modern counterpart, and on some farms sped through to stem extension earlier.

"The influence of early crop growth on its ability to withstand damage is something we should look at in year two," notes Keith. "We're also keen to scale up at each site with more replication, and will work with the Sleuths to ensure we keep the trial design easy enough to implement."

On each of the 10 farms, four plots were established, while the four with the Blackman wheat added two extra plots to the trial area. Two slug refuge traps were placed in each plot and monitored by the farmers twice a week.



well as a LEAF (Linking Environment And Farming) Demonstration Farm.

"We were keen to work with research partners to develop novel technologies and techniques," continues Andrew. "One example was utilising biofumigant crops for PCN. What were the possible unintended consequences of confining gas underground? We wanted to explore the limits to truly understand the effect on soil-borne mycorrhizal fungi

and other beneficial microbes."

The public-funded project brought together PES Technologies, who have developed an in-field tool that measures microbial biomass, with academic partners, working with Elveden. It brought Andrew a yearning to explore further this approach to research and innovation, and TEAM Ag was set up.

"We want to combine academic with on-farm knowledge, improve networks ►

The genetic wonder of Watkins

It was how Watkins 788 behaved in lab-based feeding trials that initially sparked interest in the genetics, explains Dr Simon Griffiths at John Innes Centre, who leads the BBSRC-funded Developing Sustainable Wheats (DSW) programme.

"The Watkins Collection comprises 827 landrace varieties brought together in the 1920s and '30s before systematic plant breeding began. We've used genetic and genomic technologies to reduce these down to 120 representing the genotypic diversity of the original collection.

"This is a far greater pool of wheat genetics than is currently available in elite lines, offering breeders traits that simply don't exist in modern wheats," he notes.

These 120 wheats were screened through feeding trials at the JIC Insectary in 2015, as part of the Defra-funded Wheat Genetic Improvement Network (WGIN). Slugs were given a choice and

their behaviour studied. Watkins 788 was a line consistently spurned.

Tests are now underway at JIC to confirm this finding, as well as look at other aspects of feeding behaviour that have been requested by BOFIN members involved in the project. Scientists are also testing 77 recombinant inbred lines (RILs) that have been crossed with Paragon, a relatively modern spring wheat used frequently in research.

"We need well over 1000 slugs to run these trials, so we're appealing to farmers and others interested in getting involved to send in slugs," says Simon.

The volunteer "Slug Scouts" are provided with a pack that includes containers and postage-paid envelopes, as well as instructions on how to set up an effective field trap to capture slugs.

For more about the project and to enrol as a Slug Scout, visit bofin.org.uk.



BOFIN is appealing for farmers to send in slugs to John Innes Centre for feeding trials, providing the volunteer slug scouts with resources and postage paid envelopes.

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► and apply these to novel technologies to catalyse that partnership. While there may be many farmers and farm managers who want to benefit from this, few can afford the headspace to make it happen, which is where TEAM Ag comes in. We want to be part of collaborations that remove the blockers to on-farm improvements in productivity,” he says.

Andrew cites as an example how the day-to-day running of an arable farm can get in the way of the pursuit of innovation. “Many of us have lived that enthusiasm at the start of an on-farm trial. Then it gets to the busy spring and summer periods and the monitoring or the focus lapses and the outcomes are compromised. That’s where TEAM Ag steps in to take responsibility of the trial and bring it to fruition.”

That can take any guise, from day-to-day trials logistics to strategic business support to bringing in specialist agricultural R&D concerns. “Farmers are fantastic innovators and flexible in their approach. What we aim to do is provide the support they require without being prescriptive, to retain that flexibility.”

A change in cultivation practice, for example, will be unique to any farming system, he points out. “Farmers rely on proxy measurements to gauge their progress. These don’t take account of managing dry periods on a light-land farm or the landlord/tenant relationship. So

let’s design the tools to measure soil structure and the effect of cover crops to ensure the path taken is the best informed.”

So why the interest in slugs? “Throughout my farming career, I’ve worked on silt farms with OSR in the rotation. We’ve progressively reduced cultivations and as we have, the impact of slugs has proved a blocker to improvements in productivity. And yet all we have to manage this impact is one active ingredient, applied hit-and-miss through pellets,” notes Andrew.

“What drew us to this project is that it takes a totally different approach. It may take many years before we have a slug-resistant wheat, but if we don’t take a long-term view to managing slugs, we will never achieve the right outcome. And what we’re learning along the way is invaluable.”

Jamie has kept in touch with the other Slug Sleuths through WhatsApp, trading information on everything from prevalence of beetles and their role in slug control, to trial design and layout, to the growth habit of this unusual wheat.

“On the face of it, the absence of slugs means we’re no closer to finding the slug-resistant trait,” says Jamie. “But the trial has opened our eyes to a multitude of ways we can reduce the impact of slugs, and the tools we can rely on to validate our approach as we develop it. That’s progress, so I’m looking forward to what we learn in future years.” ■

The value of collaboration to innovation

The first year of the Slug-Resistant Wheat project, which started in April 2022 and is led by BOFIN, is supported through a contribution by the Environment Agency as part of its Environment Programme. This supports partner-led projects in a Catchment Based Approach to improve the chemical and ecological quality of waterbodies.

The 10 farmers were paid around 80% of their direct costs, including time, of co-designing and carrying out the trials, for collaborating on progress and for communicating results and findings, which on average worked out at £2,867.53 each. 80% of the group’s R&D, facilitation and project management costs were also funded.