

AHDB

*from theory
to field*

Ahead of the imminent RB209 update, AHDB has invested in several projects on nutrient management to help guide the changes. CPM finds out more.

By Charlotte Cunningham

Managing nitrogen has been hot in the headlines over the past few months.

But ahead of the curve, AHDB has invested in a number of projects on nutrient management which will ultimately provide the foundations for updates of the RB209 guide, with the next version expected in spring.

Among these is a project titled 'Nitrogen and sulphur fertiliser management to achieve grain protein quality targets of high-yielding winter milling wheat' which is being led by NIAB, alongside other industry partners including SRUC, Agrii, Omex, RAGT Seeds, KWS and Allied Technical Centre.

The project is framed around the challenge with current N recommendations for high-yielding winter milling wheat to achieve optimum protein quality, explains Dr Nathan Morris, senior specialist in farming systems and soils at NIAB and project lead. "The concept for the project arose in 2017/18 when discussions of revisions to RB209 started.

"The data that had been reviewed for that purpose showed that there were knowledge

gaps for the nitrogen management of some specific crops, and one of those was milling wheat — with particular interest around some of the more modern, high-yielding varieties and the impact on nitrogen and sulphur doses/timings for growing these crops to attain milling wheat specifications."

Baking performance

As well as this, another key driver was the supply chain and millers, he adds. "Millers are very focused on ensuring the throughput for modern flour mills and processing the grain to achieve their requirements for the UK's diverse baking industry and retail sectors.

"They were becoming increasingly interested in understanding more about the link between crop agronomy and grain quality. Particularly, this includes protein quality, rheology and baking performance. This is something that's not really been looked at in detail in previous studies to really gain a full understanding of what a farmer applies to his crop and what the result of that is in terms of flour quality."

The project was ambitious, with five key aims, but with the ultimate goal of using the research to guide updates to N and S usage in winter milling wheat, notes Nathan. "The first stage was consulting with the wider industry to home in on exactly where the knowledge gaps are regarding their management for winter milling wheat. This ultimately formed the basis of field trials.

"Moving onto the trials, we started with comparing grain quality — specifically, protein, Hagberg falling number and specific weight — responses to different N application rates and timings.

“ Millers have become increasingly interested in understanding more about the link between crop agronomy and grain quality. ”

Strategies for success

"This included foliar applications at the milky-ripe stage, on a range of soil types and growing environments across three different varieties: KWS Zyatt, KWS Siskin and RAGT Skyfall — all of which were mainstream varieties at the start of the research.

"We then ran a similar study, but this time looking at the interaction of sulphur on grain quality and baking performance."

These trials also looked into sulphur usage and the production of asparagine, which has been associated with potentially carcinogenic properties and it's produced during the baking process where the levels can be high. That can lead to increased risk to consumers, explains Nathan. "This is still being investigated at present, but effectively we're aiming to see if there's a better way of managing sulphur to reduce these



The difficult weather over the past three seasons has posed a real challenge for the research, explains Nathan Morris.

levels as much as possible.

"This takes us up to where we're at now, where I'm in the process of doing the number crunching to assess the impact of fertiliser rate and timing on dough rheology and baking performance and for S applications, the production of asparagine."

By far the biggest challenge has undoubtedly been the weather — after a difficult few seasons during the crux of the trials, the headline findings are not yet as clear as we'd hoped, explains Nathan. "Initially, we set out to run between seven and nine trial sites across the three years to provide a robust data set, but the extremely wet weather impacted this massively. In fact, one of the sites was completely lost because of how wet it got over winter — the seed quite literally just rotted in the ground."

At the other end of the spectrum, another challenge — and one that was bigger than



The milling and processing industry have been key drivers in the research into the nitrogen and sulphur application and the effect these have on flour quality and baking.

Nathan says he'd envisaged — was around the application and timings of N when the weather came extremely dry in the spring. "While we'd thought about our timings, looked at previous evidence and created a protocol for applying the N, with the spring months coming as dry as they did this no doubt effected uptake."

Weather interactions

"Naturally, some of the results do reflect this and we had low yields purely due to the combination of a difficult autumn followed by a very dry spring. Unsurprisingly, this had knock-on effects on protein and specific weights, making drawing accurate conclusions somewhat of a challenge.

"I'm looking further into this weather interaction at present to better understand the implications. Though it did serve as an important reminder to really keep in mind the weather when considering N application and uptake."

Looking at some of the data available now, there were some notable key findings from the first year of field trials (across four sites), explains Nathan.

"Firstly, despite relatively high nitrogen rates (320-345kgN/ha), very few grain samples achieved 13% protein. Also, no consistent trend from the addition of sulphur (≥ 75 kg/ha SO_3) was apparent when it came to reducing asparagine.

"What's more, high Hagberg falling numbers were only achieved at two of the four sites and the wet weather at harvest was likely to have contributed to this.

"It's important to stress that this was from a single season and further analysis is needed before any specific recommendations



Upon completion of the study into nitrogen and sulphur usage on milling wheat, the findings will be presented to a team of experts who will decide whether they should be included in an RB209 update, explains Georgina Key.

can be fed back to AHDB," he concludes.

The project was due for completion in March this year but has now been extended to May 2022 due to some of the trials needing to be repeated as a result of the poor conditions, explains Georgina Key, resource management scientist at AHDB. "Upon completion, Nathan will then present the findings to our panel of experts who will examine the data rigorously to decide whether or not it should feed into the RB209. If it's decided that it should, an update to the guide will be provided in 2024."

In a related project, Hill Court Farm Research, in partnership with NIAB and CF Fertilisers, has recently completed a study into the early prediction of grain protein content to guide nitrogen ►

Industry-driven research

With the processing industry being one of the key drivers behind the nitrogen and sulphur in milling wheat project, Allied Technical Centre was contracted to carry out the pilot milling and baking work, explains Mark Charlton head of cereals, milling and baking science. "As part of this, we've been analysing the wheat, looking at the flour rheology and baking, to decipher what agronomy regimes impact on the end product quality for the consumer.

"At this moment, we're actually in the process of baking the last three sets of samples from the 2021 crop."

Mark explains that the research was originally sought by nabim — now known as UK Flour Millers. "This was partly after looking at the RB209 guide, but also as it was important for

the wider industry to gain a greater understanding of whether there was a difference between applied nitrogen levels and the end result.

"What's more there's been a lot of noise about reducing asparagine in wheat as this has been associated with acrylamide, a potential contaminant formed from asparagine during the baking process. Sulphur inputs minimise asparagine formation but there's a balance to be found as sulphur also increases gluten bonding in wheat and it's the gluten quality that is important for baking."

For the processing sector, having a greater understanding of the cereal science is really important, thus justifying the value in this research, adds Mark. "UK millers want to be using UK wheat and they also want that wheat

to be the best quality it can be. So if there is a way that this can be optimised through application and/or timing of nitrogen and sulphur then it's really important to do so.

"From another perspective, while the environmental impact of inputs certainly wasn't part of the original brief, if you look at the past 6-9 months and the conversations over nitrogen and climate change, then there might be some obvious links between what farmers and processors do. But ultimately, the aim was to look at the milling and baking functionality."

Mark adds that it's too soon to discuss results as the analysis of all the samples are still underway. "However, it'll no doubt be an important piece of research for both growers and processors."



Nathan's trials with nitrogen compared grain quality – specifically, protein, specific weight and HFN – responses to different N application rates and timings on three varieties: KWS Zytatt, KWS Siskin and RAGT Skyfall.

management in winter milling wheat.

► The ethos of the project has been based on creating a concept to predict grain protein content during late stem extension — GS37-39.

Researchers say accurate predictions would help target N applications more effectively and, critically, could help farmers decide whether to continue with a milling-wheat strategy or to shift to growing lower-cost feed wheat instead.

Testing has involved the collection and analysis of plant tissue samples from

Research roundup

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. CPM would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.

For further information:

AHDB Project No 21140040 'Nitrogen and sulphur fertiliser management to achieve grain protein quality targets of high-yielding winter

milling wheat' is led by NIAB and runs from 1 July 2018 to 31 May 2022 at a cost to AHDB of £179,548 (total £230,999).

AHDB Project No 21140041 'Early prediction of grain protein content to guide nitrogen management in winter milling wheat' is led by Hill Court Farm Research in partnership with NIAB and CF Fertilisers and runs from 11 May 2020 to 31 November 2021 at a cost to AHDB of £8,885.

across two seasons at the milling wheat experimental sites. "Now complete, the findings of the study showed a good relationship between the predicted protein content model and what was actually achieved at harvest," explains Georgina.

"This was based on measuring the N status at three different growth phases, across three varieties."

Georgina explains that the researchers would one day like to turn the findings into a tool for wider use. "While the RB209 can provide general, overarching advice, services like this may be able to help growers get more specific information about their N applications. However, in the immediate future, they are looking to refine the findings further first." ■



Nathan's study also looked specifically at sulphur applications and the production of high levels of asparagine, which has been associated with being a trigger for acrylamide formation which is potentially carcinogenic.

RB209 update

Almost five years on since the first update of the AHDB-led RB209 nutrient management guide, the organisation is gearing up to provide growers with another update in the spring, based on the findings of several research projects which concluded in 2021.

"As well as the projects, we commissioned work looking into lime and we've also been able to take advantage of the HS2 work with a unique opportunity to access and analyse the thousands of soil samples that were collected before digging commenced," explains Georgina.

"These were analysed by a consultant and formed the basis for updated advice on soil sampling, pH and the timing of application of lime and other nutrients."

So based on this, what can growers expect from the update?

According to Georgina, the key changes for section 1 include:

- New subsoil recommendations to improve estimates of soil nutrient supply and lime requirements
- New clay classification (in relation to potash release and applications)

- Revised magnesium section, with enhanced guidance on:
 - Soil types most at risk of low magnesium indices
 - Potential risk of magnesium deficiency in arable crops
 - How to increase magnesium indices (when required)
 - Management of soil types with high magnesium indices
 - Revised soil acidity and liming section, with enhanced guidance on:
 - The role of soil pH in fertiliser-use (mineral and organic) efficiency, including nutrient availability, and the reduction of green house gases (nitrogen lost as nitrous oxide)
 - Improved calculations of lime requirements according to soil type
 - How to make maintenance/top-up applications of lime that account for losses, crop offtake and other acidifying factors
 - Consideration of the reactivity (fineness of grinding) of liming materials, which influences speed of action
- The update will also feature guidance on



adapting nitrogen rates, in light of the recent record-breaking prices and supply shortages, she adds. "The spike in prices mean growers now have to also consider the 'economic premium' of their applications. In other words, the point at which the value of extra yield is not worth the cost of additional nitrogen.

"We commissioned a series of very short, intensive projects to take a look at the grain price against current fertiliser values and the breakeven ratio. Cereals and oilseeds tables within the guide have now been expanded to take these higher prices into account.

"We've also created an online calculator to help growers assess this, which is available to access now."

Work on the economics of nitrogen has also been carried out, with findings and guidance from this expected imminently, she concludes.