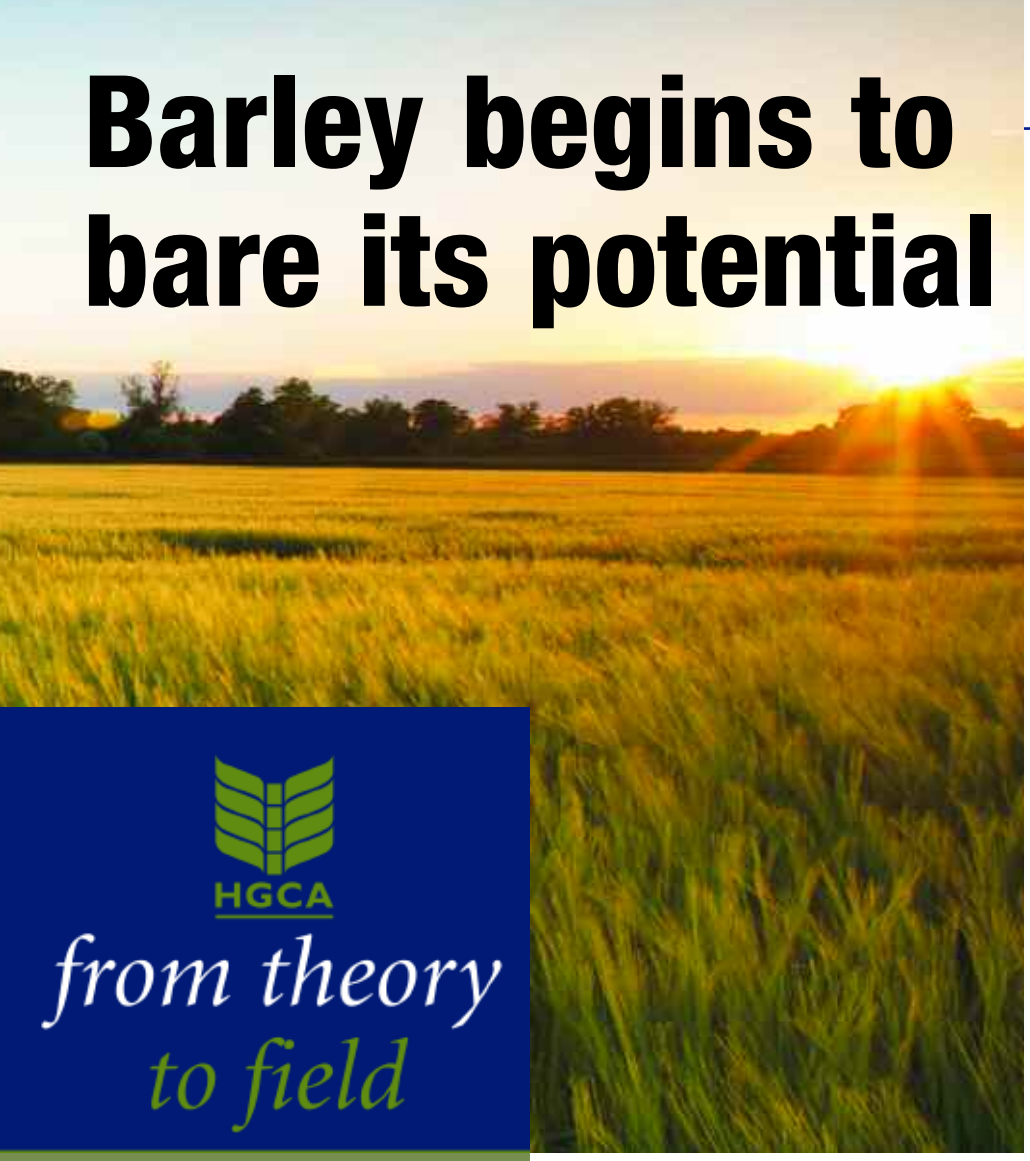
Barley begins to bare its potential



HGCA *from theory to field*

Newer barley varieties bring the promise of sizeable yields, but these are rarely delivered on farm. *CPM* explores recent and current research that's shedding new light on how input strategies can be adapted.

By Tom Allen-Stevens

Once the Cinderella crop, barley has become the belle of the ball. The new HGCA Recommended List for spring barley positively bristles with attractive new lines, while so confident is Syngenta in the performance of its Hyvido hybrid winter barleys, it offers growers money-back guarantees. Even new conventional varieties are nudging 10t/ha in RL trials, and yields above 12t/ha have been recorded.

Yet for all the genetic potential paraded in front of growers, once brought back on farm, the promise of a dazzling display appears to dwindle into a disappointing final result — 6.5t/ha is the actual average UK yield from winter barley. Dr Susannah Bolton of HGCA is one of many in the industry who believe this under performance can and should be addressed.

"It's clear that barley is becoming a more important crop. It's not just that it's a key second cereal under the three-crop rule. It plays an important role in the rotation and helps against blackgrass," she says.

Genetic advances

"But the crop's suffered under-investment in terms of research. We now need to bring it to the same level as wheat. What's more, there are really interesting genetic advances — hybrids and new high-yielding conventional types — that use nitrogen in a different way. We need to understand that, how to bring the benefits onto the farm, and how to manage the crop effectively."

These are the objectives of an HGCA-funded research project, carried out by ADAS, that's currently under way (see panel on p31). It's part of a £700,000 research package aimed at updating nutrient management recommendations, she explains.

The project has reviewed historic data, with new experiments, looking at N rates and timings for winter barley, conducted over three years. It's been running for a year and a half, and initial results suggest RB209 does indeed underestimate the optimum N rate, while applying N earlier has been shown to bring yield benefits, points out Susannah Bolton.

"But the project is not just about yield. Quality is equally important, especially for the premium markets. So the research is also looking at the effect of different N regimes on grain N."

For Dr Pete Berry of ADAS, the lead scientist on the project, it's the Fertiliser Manual, RB209, that needs refreshing. "The development work behind the current recommendations for barley haven't been updated since the 1980s," he points out.

More recently, an industry-funded LINK project (see panel on p31) has provided further insight into how barley develops and the components of yield. "Getting yield into barley requires a slightly different approach from wheat. The crop is sink limited, so the yield is set by the number of grains/m^2 the plant develops," he explains.

"That's primarily down to the amount of light intercepted between plant emergence and flowering. You need to produce about 20,000 grains/m^2 before you can achieve a crop of 10t/ha or more," continues Pete Berry.

"You then have to fill those grains, and maintaining a healthy green canopy for a crucial five-week period after flowering is sufficient. This contrasts with wheat, where the longer you keep the leaf area green, the more you'll maximise grain fill," he adds.

The new project has a firm focus on nitrogen management. The first stage has been to review recent research that's sought to look closely at N applied to winter barley, and in particular optimum timings. In all, 25 N timing experiments were reviewed.

"From 2006-2010, we did some work

> *"Getting yield into barley requires a slightly different approach."*

with GrowHow, for example, looking at different rates and timings for two-row and six-row winter barleys. This concluded that newer varieties need more N than RB209 recommends, while earlier timings results in more yield."

RB209 recommends 25-30% of N is applied before early stem extension, while the British Survey of Fertiliser Practice reveals that growers currently apply around 30-40% of their N before this timing.

"We statistically analysed all the data from experiments and found there was actually a 0.5t/ha yield increase from applying more than 50% of N before early stem extension, compared with less than 30%. This suggests that if growers apply N earlier than they are at the moment — certainly earlier than RB209 recommends — that'll bring quite a significant yield improvement," notes Pete Berry.

What's more, there's an effect on grain N. "We looked at a range of different total N rates at both the early and late timings in the GrowHow-funded experiments. Consistently, the earlier N strategy reduces the grain N by about 0.1%, which is important for achieving various market specifications." (see chart on p30).

The earlier N also increases the straw yield by 0.3t/ha to 1t/ha and the crop height, by about 10cm, which has implications for lodging risk, he adds. "More than three quarters of UK barley crops receive a PGR, of which more than half is just chlormequat. That won't shorten the crop by very much and shouldn't be relied on to reduce lodging risk."

Chlormequat is effective at boosting yield where there's no lodging by helping to build tiller numbers, he explains. It regulates the amount of gibberellic acid produced by the plant at GS30-31, and analysis of past data has shown this has a small but significant effect on ear numbers.

Initial results from the current project suggest RB209 underestimates the optimum N rate, while applying N earlier brings yield benefits.

"But if you're pushing for a higher yield, and particularly where applying N early, an ethephon PGR should be used at the T2 spray timing (i.e. GS37)." Examples include Cerone (2-chloroethylphosphonic acid) and Terpal (2-chloroethylphosphonic acid+ mepiquat chloride).

Optimum N rates were also reviewed, and for those crops yielding around 8t/ha, the RB209 recommended rate holds true, says Pete Berry. "But crops with a higher yield potential require more N than RB209 advises — on average, the optimum N ▸

There are interesting genetic advances in barley that use nitrogen in a different way, says Susannah Bolton.

Maintaining a healthy green canopy for a crucial five-week period after flowering is sufficient to fill the grain sites, says Pete Berry.

▸ rate was about 27kgN/ha above the RB209 rate for each tonne above 8t/ha."

The project is also conducting new trials over three years, working with GrowHow and Syngenta. These look at the N timing and optimum rate across six varieties, with N applied at six rates from 0-360kgN/ha, explains Dr Sarah Kendall of ADAS.

"We're comparing four modern varieties — Cassia, Meridian, Venture and Volume — with two types grown in the 1980s — Maris Otter and Halcyon or Pastoral."

The 2014 experiments received a standard fungicide programme, which was sufficient for the modern varieties, but not always robust enough for the older varieties such as Maris Otter, she comments. All 2015 and 2016 experiments will receive a "belt-and-braces" approach, not dissimilar to one an RL trial receives and including SDHIs, to ensure all varieties can achieve their full yield potential.

The trials are sited at ADAS Rosemaund in Herefordshire and High Mowthorpe in N Yorks, with another trial in Scotland commissioned by Syngenta and run by Scottish Agronomy.

"Preliminary results after just the first year of trials indicate that new, high-yielding varieties do need more N. As the yield potential of these varieties increases, there's a trend for the optimum N rate to increase, too," she reports (see chart opposite).

"You don't get that in spring barley, however — similar HGCA-funded work we carried out some years ago concluded there was no difference in the optimum N rate between the old and newer varieties trialled."

Mitigates increase

So what about the effect on grain N? "That's particularly important for Venture, the new malting variety in the trials. As a rule of thumb, each extra 30kgN/ha should increase the grain N by 0.1%. But it's going on earlier, which mitigates the effect. Venture at the optimum N rate at Rosemaund was achieving 1.9%N," she notes.

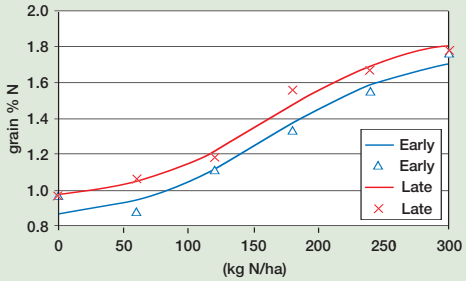
What's more, higher yields result in a dilution effect — in Scotland, the optimum N for Venture was 193kgN/ha, bringing a yield of 11t/ha, but a grain N of just 1.66%.

"There are four different N timings in the experiments," continues Sarah Kendall. The RB209-recommeded timing puts just 30% of N on before stem extension, while the best result from the data review — 50% of N before stem extension — makes up the second timing.

"We're also looking at the effect of applying 75% of N before stem extension and in addition, putting 30kgN/ha of this into the seedbed, although this isn't allowed under current NVZ regulations."

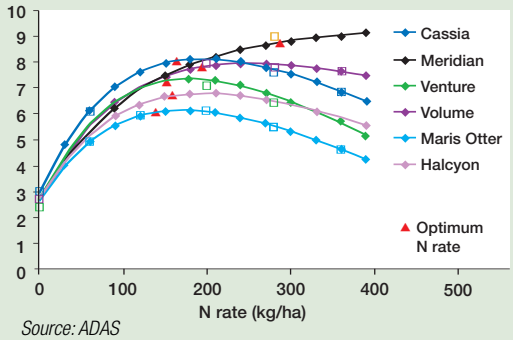
In the first year, the autumn-applied N, put on ten days after the crop emerged, showed no benefit. "But then the crop shut down in Oct or Nov, so maybe it didn't have time. This year it was applied to the seedbed, and there may have been more of a chance for the crop to utilise it before winter set in."

Effect of earlier N on grain N content



Source: ADAS (research funded by GrowHow)

Optimum N rate for winter barley



Source: ADAS

Barley back and measuring up for Wolds grower

It was the lure of the new varieties that pulled Andrew Manfield back into winter barley. A partner in Manfield and Knapton, he farms 200ha based at Hessleskew Farm on the exposed E Yorks Wolds, 130m above sea level.

"We've been growing a substantial area of spring barley for malting. We moved into oilseed rape reluctantly when the York sugar beet factory closed and needed an entry crop, so grew winter malting barley for a while, but subsequently moved out of it," he says.

"The advent of the new high-yielding six-row barleys tempted us back in. We're also back into fattening cattle, so have an outlet for the grain."

A small area of Hyvido Volume was grown last year as a look-see. An 8ha field of the same variety has been planted for 2015 harvest. "I don't think the new varieties are necessarily that much higher yielding, but they overcome adversity well — we're on a very exposed site, with stony, high-pH soils, and frost heave over winter. It's not that easy to get a good seedbed, but the crop compensates and fills in the gaps well."

His nitrogen strategy is to push the crop quite hard, starting early on. "We'll be putting on 220kgN/ha in total, with half going on at late tillering and the rest just before stem extension. We're aiming for 9t/ha."

This year, he's also hosting some of the HGCA-funded winter barley trials. "I jumped at the chance of having the trials here. We're part of an Innovate UK project testing a new sensor with Cranfield University (see *CPM* Oct 14 issue). I'm keen on precision placement of fertiliser, so curious to see what the HGCA trials will conclude," says Andrew Manfield.

Andrew Manfield reckons the key benefit of new barley varieties is that they overcome adversity well.

"Most all, I'd like to see variety-specific programmes for nutrition. We know varieties respond differently to N inputs, but don't yet know how that translates into a tailored fertiliser strategy. It could be an easy win and bring significant returns in terms of both economics and the environment," he points out.

Preliminary results indicate that new, high-yielding barley varieties do need more N, reports Sarah Kendall.

Otherwise, preliminary results suggest earlier timings bring increased yield, confirms Sarah Kendall. "But there's a health warning — there's the risk of N leaching where it's applied too early. A Feb application followed by a deluge will wash it through the soil before the young crop has a chance to take it up."

There's also the increased lodging risk, and this is being measured to understand more about the impact of earlier N and higher rates, while more data is also being gathered to refine understanding of grain N. "The data we get over the next two years should also give us more consistent conclusions about the N rates and timings across a range of different sites," Sarah Kendall concludes.

But tweaking the N regime isn't the only way to get more out of your barley, notes Pete Berry. One of the major aspects explored in the LINK project was the physiological response of the crop to fungicides.

"The yield response from disease control is well documented. What we were looking to determine was whether there was a response when little of no disease was present. We found in those situations, there was still a significant yield response of almost 0.5t/ha."

Where disease pressure is high, the LINK project concluded that fungicide treatments at T1 (GS25-30) and at T2 (GS37-49) will be needed. If disease pressure is low to moderate, the conclusion was that a single dose of prothioconazole plus pyraclostrobin (the actives used in the trials) at T2 was sufficient to protect the crop, although Pete Berry advises a two-spray programme in moderate situations.

"But the important finding is that even in the absence of physical disease, a single application at T2 was likely to result in a yield benefit of 0.3-0.6t/ha," he says.

"The mechanism for this isn't fully understood — we've measured that the yield increase is coming from having more seeds/m^2 and bigger grains. It's possibly through a direct effect on plant metabolism, but it's certainly not an effect of prolonging the green area of the leaf canopy — more work may be needed before we really know what's going on." ■

HGCA project 216-0006, Updating N fertiliser management guidelines for winter barley, runs from Aug 2013 to Feb 2017. Its main aim is to review e xisting evidence and generate new data to update the Fertiliser Manual (RB209) N management recommendations for winter barley. The project is led by ADAS, with GrowHow and Syngenta as industry partners. Its total cost is £174,000, with £150,000 funded by HGCA.

HGCA project RD-2004-3017 (PR 470), Targeting winter and spring barley disease, ran for five years from July 2004. Its main aim was to test the mechanisms by which fungicide treatment affects the growth of barley, so that sprays might be better targeted. The total cost was £833,052, of which HGCA contributed £32,694. Led by SRUC, with ADAS and TEAGASC, the project was co-funded by Agrii, Agrovista, BASF, Bayer CropScience, and the Scottish Government through the Sustainable Arable LINK programme.

The HGCA Barley growth guide (2006) explores facets of barley development with the aim of improving understanding of how the crop develops and grows in the field to help growers identify where production may be falling short of potential.

For more information, visit *www.hgca.com*