

Re-thinking 'the why' with variable rate N

"Research has always suggested modest gains from variable rate N."

MARK TUCKER

New research reveals that variable rate nitrogen applications result in only minor improvements to yield, gross margin, and greenhouse gas emissions, compared with a standard flat rate. *CPM* investigates what this could mean for growers.

By Janine Adamson

Maximised crop potential, optimised input costs, and a reduced impact on the environment – just some of the historical claimed benefits to be had from adopting variable rate nitrogen applications. However, what if research suggests all is not what it first seems?

According to new findings from ADAS, variable rate N delivers only small yield and margin gains, and a minimal reduction in greenhouse gas emissions, when compared with the flat economic optimum N rate for the whole field. Similar results were found across three key crops – winter wheat, winter barley and oilseed rape.

The work was conducted on 11 commercial UK farms over five years, and involved dividing single fields into small square plots with different amounts of nitrogen applied to each, N response curves were then used to calculate the 'optimal' N rate for each

plot. Besides N, all other inputs and applications remained the same.

As well as the field's optimum rate, the variable rate scenarios were also compared with other N rates including the UK average from the British Survey of Fertiliser Practice, and the RB209 recommended rate for each field.

TRIAL RESULTS

The subsequent results indicate that on average, varying N rates would have increased yields by about 0.05t/ha and improved margins by roughly £10/ha. Equally, only a small reduction in greenhouse gas (GHG) emissions per/t of crop produced would be achieved.

"We found that using variable rate N would result in some small yield and gross margin gains, but ultimately most benefits came from being closer to the field optimum rate," explains Dr Kate Storer, ADAS principal research scientist and lead for the project.

For further context, within a single field, yields varied by up to 2.5t/ha for wheat, and the optimal N requirement differed by more than 200kgN/ha (oilseed rape) between areas, highlighting the significant within-field variation.

"These differences highlight exactly why precision farming tools are considered promising – crop



Trial findings

The work suggests tailoring nitrogen applications using variable rate offers relatively little gain over applying an accurate flat optimum N rate across the field, explains ADAS' Dr Kate Storer.



Understanding the goal

Agrovista's Graeme Barrett raises that with variable rate, the original goal was never to reduce fertiliser quantities, or have a direct impact on greenhouse gas emissions.

requirements aren't uniform, even within the same field," adds Kate.

Considering environmental impacts of fertiliser use, the research indicates a similar pattern - adjusting N rates within fields had very little impact on overall modelled GHG emissions when compared with using a flat optimal N rate for the whole field.

When a flat optimum N rate was used, the GHG emissions from applying above the optimum in some areas of the field were cancelled out by reduced GHG emissions when applying below the optimum in other areas, highlights Kate.

"The findings indicate that tailoring nitrogen applications using variable rate offers relatively little gain over applying an accurate flat optimum N rate across the field. But estimating the perfect optimum N rate is difficult, so it's important to utilise all relevant methods, including in-season adjustments, to be as accurate as possible."

Co-author Dr Sarah Kendall raises that there's a current renewed focus on fertiliser rates as nitrogen prices rise. "Yet, the results were similar when tested under increased fertiliser prices, suggesting that variable rate won't necessarily provide greater benefits with a higher ratio of N:grain prices.

"However, prioritising understanding field-level fertiliser requirements through soil assessments, crop monitoring, and decision support tools is key. The greatest value of variable rate is likely to result from helping to get as close as possible to the field average optimum N rate,

rather than the actual delivery of different N rates within a field," she suggests.

Agrovista's national precision services and rural consultancy manager, Graeme Barrett, raises that with variable rate, the original goal was never to reduce fertiliser quantities, or have a direct impact on greenhouse gas emissions. "In fact, in terms of overall quantity applied, it's often the same as the flat rate, and in some cases, can be more.

"Instead, it's about optimising crop yield and achieving uniformity. Part of that involves understanding whether the soil can sustain an increase in yield through feeding the crop, so what are the reasons behind the poorly performing areas of a field?" he argues.

BIGGER PICTURE

In Agrovista's case, this has meant utilising an alternative approach to NDVI data – the primary intelligence driving most variable rate applications. "We don't look at just one snapshot of NDVI as this can sometimes prove unreliable. Instead, we stack up to eight years of NDVI data, plus additional information such as elevation, field productivity and soil health.

"Compaction can look like a poorly performing crop and won't necessarily respond to applying greater quantities of fertiliser. Equally, different soil types respond to nutrition in very different ways, particularly in respect to nitrogen.

"But by looking at this wider information and acting accordingly, I believe it's possible to achieve a yield uplift beyond what these trials would suggest, which in honesty, I'm surprised by," comments Graeme.

Yara's Mark Tucker agrees, stating that while not all variable rate systems are the same, most scenarios result in the same amount of fertiliser being applied as a flat rate. "Equally, I think it would be wrong to assume there'd ever be a huge yield uplift, research has always suggested modest gains from variable rate N.

"In fact, years of work by Yara suggests a 3-4% benefit is more realistic. While small, an incremental gain can be significant to an individual, depending on the scenario," he says.

Furthermore, he stresses that nutritional trials are never black and white. "It's challenging to achieve statistical analysis due to the many variables at play, such as the previous crop, soil type or recent tillage. With such variability, it would be wrong to apply a flat rate, and satellite NDVI has helped to visualise this for us so we can respond accordingly.

"Therefore, the aim should be to match the supply and demand of the crop as closely as possible, for optimised nitrogen use efficiency (NUE). If we can approach this from a different mindset – truly grasp why we're doing this – then variable rate can be effective."

Mark stresses that for many Yara customers, it's the wider agronomic benefits of variable rate N that actually matter. "For them, achieving a homogenous crop improves lodging control, combine performance, or helps to achieve milling specification. In many ways, potential yield improvements are less critical."

Reflecting on the new research, Omex's David Booty believes the strategy should remain to truly understanding crop requirements to inform selecting the right product and application strategy. "Applying the right product, in the right place, at the right time remains the most effective route to improving nutrient use efficiency and supporting sustainable crop production," he continues.

"Where growers identify a clear economic benefit from variable rate applications, liquid fertiliser systems can often deliver this more accurately and efficiently, helping to translate field data into precise nutrient placement."

To round up, considering the emissions side of the trial in more detail, Graeme adds that greater reductions could probably be achieved by utilising variable rate for other inputs. "I think the gains would be more significant overall from variable rate P, K and lime," he concludes. ●



Modest gains

Yara's Mark Tucker believes it would be wrong to assume there'd ever be a huge yield uplift with variable rate N, with research always suggesting modest gains.