



Zoning in on net zero

Crop nutrition

Managing crop nutrition is a nuanced subject at the best of times but add in net zero goals and it becomes a whole new ball game. *CPM* explores how crop nutrition can go hand-in-hand with environmental goals.

By Melanie Jenkins and Rob Jones

The impact of climate change on agriculture is an on-going concern for the industry, however, fine-tuning crop nutrition and how it's manufactured can make a difference and help the industry work towards net zero.

Farming has regularly had the finger pointed at it as a contributor to greenhouse gas emissions, highlighted Sir Peter Kendall at November's CropTec Show. Speaking in his capacity as a farmer, Sir Peter feels that the subject is an important one and is addressing it on his home farm having cut back on bagged fertiliser when prices skyrocketed in 2022. Instead, he's turned to using litter from

his own broiler chickens.

"The whole discussion on how we can fine-tune nutrition is really important, relevant and timely, not just for the profitability on farm but also for our carbon footprint moving forward."

Emissions

Inorganic fertiliser can often be seen as a major culprit in terms of GHG, but according to Yara's Mark Tucker, it's a coin of two faces. "Fertiliser is good in that it can double yields across the world but it's bad in the sense that this comes with emissions that stand out in a sustainability audit.

"As a company, Yara produces 20M tonnes or more of fertiliser every year and this has huge emissions and fossil fuel consumption associated with it, but we do have a net zero initiative which comes with a requirement to invest in how we achieve that within the business."

To achieve this, Yara is moving to fossil fuel-free fertilisers in the form of generating green hydrogen, which can be used to produce green ammonia. "This has kicked off in Oslo, Norway, and it'll be used in the UK for the first time in 2024 to grow wheat, barley and potato crops."

The green hydrogen is created in Norway through the use of hydro-electric power and in other regions will be produced using a combination of wind and solar power, explains Mark. "This is a huge win for sustainability, but it does come at a huge cost."

“The whole discussion on how we can fine-tune nutrition is really important, relevant and timely.”

With the increased use of different forms of hydrogen, he points out that the industry will have to get used to the terminology in the production of hydrogen, which includes grey, blue, green and even turquoise. ▶



A detailed soil test was conducted at Cobbs Farm before sowing cover crops to provide a baseline of core soil properties.

► “The second element in Yara’s journey to net zero is more about the recycling of nutrients. Another way we can bring nutrients back into farming and food production in the UK and Ireland is in the form of organic-based fertiliser which is created from waste food and green waste, or compost. This also reduces our reliance on fossil fuel-based fertiliser and helps to

both decarbonise production and reduce the overall carbon footprint.”

However, Mark says it’s not a simple task and flags that huge investment is required to achieve these more sustainable operations. “There’s a lot of money going into decarbonising industrial scale electrolysis and carbon capture. That cost will have to be shared across

the supply chain but we feel it’s a feasible achievement to reach net zero.”

At farm level, the Albanwise Farming partnership is taking actions to make the most of crop nutrition. According to chair Phil Jarvis, it’s been a team effort on farms across Yorkshire and Norfolk to manage the different soil types. “Nutrition on each soil comes from the individual manager on ►

CRF for productivity gains



Controlled Release Fertiliser technology could bring productivity and environmental benefits to UK growers, says Andrew Judd.

Controlled Release Fertiliser (CRF) technology, proven in independent trials and commercial crop production, could bring productivity and environmental benefits to UK growers, says ICL’s Andrew Judd.

“Applications of CRF have been shown to achieve a Nitrogen Utilisation Efficiency (NUE) of more than 90%, some 50% more than the UK average of around 60%.”

Other benefits include cutting ammonia volatilisation in half and reducing nutrient leaching by nearly 60%, compared with other fertiliser practices, he adds.

“CRFs are temperature-based and designed to release optimum daily quantities of nutrients to crops over a specific timescale. This ensures nutrient availability can be matched to the specific crop requirements more effectively, which leads to higher NUE and reduces nutrient losses.

“This more efficient use of nitrogen results in higher yields per tonne of fertiliser applied while also giving growers the option to reduce nitrogen inputs if they wish to, such as when farming in nitrate vulnerable zones (NVZs).”

He says another major advantage of CRFs is that they can reduce the number of fertiliser applications required through

the season. “This reduces farm traffic, labour costs and time, as well as helping to reduce potential soil compaction problems.”

The combination of reduced environmental impact and improved productivity means CRFs could play a key role in helping UK agriculture meet its future sustainability goals, he believes. “Whether it’s reducing ammonia emissions required by the UK’s Clean Air Strategy, addressing concerns over nutrients entering water courses, or reducing the carbon footprint of food production, CRF technology brings a range of benefits to growers and the wider food supply chain.”

Explaining in further detail, Andrew says CRFs work by covering granules with a semi-permeable coating that allows water to pass through to dissolve the nutrients contained within. “The process is temperature sensitive — as soil temperature rises, cracks develop in the coating, drawing in water to dissolve the nutrients inside.

“The water then carries these out into the soil for the plant roots to take up. When soil temperature decreases, nutrient release slows down. This process can last for many weeks with the release of nutrients specifically tailored to individual crop requirements,” he comments.

“Being low electrical conductivity (EC) products, CRFs can be safely used at planting or pre-planting and can be broadcasted or direct drilled,” says Andrew.

According to ICL agronomist Scott Garnett, trials carried out on CRF have been ‘pretty conclusive’ on the benefits of the approach. “ICL’s CRF technology has been rigorously tested on a range of crops with consistent results being seen.

“For a start, conventional nitrogen fertilisers average around 60% NUE, but in a recent UK winter wheat trial, we saw an NUE of 97% resulting from our CRF technology,” he says.

Another trial undertaken in Yorkshire showed the controlled release of nitrogen from CRF increased NUE by 82% and boosted seed potato yield by 10%, delivering an extra £736/ha compared with the grower’s standard AN-based practice.



According to Scott Garnett, conventional nitrogen fertilisers average around 60% NUE, but in a recent UK winter wheat trial Controlled Release Fertiliser technology produced NUE of 97%.

Andrew says CRF technology is offered through two ICL product ranges. “Agrocote is a 100% coated nitrogen fertiliser designed to provide crops with a continuous supply of nitrogen throughout the growth cycle. The longevity of the release can be tailored depending on the requirements of the crop.

“It contains 44% nitrogen and can be used either as a straight nitrogen fertiliser directly applied to crops, or blended with other nutrients. Agrocote is particularly effective in lighter soils where N is prone to losses from leaching, as well as areas where the use of nitrogen is restricted,” he explains.

Also available is Agromaster which combines Agrocote N with ICL PKPluS. “Agromaster effectively combines two ICL technologies to provide tailor-made NPK formulas for a range of applications. Agrocote provides the controlled release nitrogen and the PKPluS delivers the other key nutrients — phosphorus, potassium sulphur, magnesium, and calcium.

“The PKPluS gives an initial early release of these key nutrients which is then sustained alongside the controlled release of nitrogen from the Agrocote over the growing season,” concludes Andrew.

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► each farm, but internal training has been really good for opening up the discussion on what's good for farming and for what crop nutrition looks like in the future."

Steps have already been taken within the partnership to push towards a more sustainable future and over the past 10 years it's increased the organic matter content of the fertiliser being used by 10% each year. "But we still can't get enough nutrition into crops by just using organic material," stresses Phil.

He points out that monitoring what's in soil to begin with can really help in the process. "Look at what tools are available so you can identify what crop nutrition you require and then plan for it to end up in the plant."

But driving change can be hard when there's already considerable risk in farming as it is, says Sir Peter. "So how do we drive this change and encourage farmers to change their thinking?"

Knowledge exchange

According to David Boulton, a Midlands-based agronomist at Indigro and AICC council director, the farming landscape is incredibly varied and includes people at different stages of the sustainability journey. "Because of this diversity in the industry there's potential for a knowledge exchange platform and I think peer-to-peer networking will become ever more important to demonstrate what does and doesn't work."



Yara is creating green hydrogen in Norway through the use of hydro-electric power and will be using a combination of wind and solar power in other regions.

“There has to be a perceived benefit to move towards a change, such as a cost benefit or yield improvement. However, I’d advise not going cold turkey initially but to implement gradual small step changes on farm. If you’re a conventional farm that cuts out insecticide, reduces fertiliser and minimised tillage and you ended up with a yield decrease of 25%, you wouldn’t necessarily know what variable had caused this outcome. But introducing gradual change will allow you to better understand what’s going on and what the impact is.”

David also suggests conducting an annual review to create a feedback loop. “Talk to your agronomist and to neighbouring farmers to see

what’s working on their farms. Also consider government incentives such as SFI as they come around.

“There are really good soil fertility building options such as herbal leys and the legume fallow mixture. These mean we can effectively rest soils in an otherwise heavily intensive arable rotation, allowing us to put fertility back into our soils in the form of soil mineral nitrogen and soil nitrogen supplies,” he explains.

According to Sir Peter, as BPS disappears, looking at SFI options could help build fertility and resilience in the farming system, as well as in farm businesses a whole. “Look at where the available support is and how it can bring a win-win to your rotation.” ■



The Sustainable Farming Incentive includes soil fertility building options such as herbal leys and the legume fallow mixes.



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Cover crop assessment results summary

	Average of all five cover crops
Fresh weight	38t/ha
Nitrogen	189kg/ha
Carbon	1841kg/ha
C:N ratio	10
Phosphate	21kg/ha
Potassium	122kg/ha
Calcium	122kg/ha
Magnesium	6kg/ha
Sulphur	26kg/ha
Boron	124g/ha
Manganese	281g/ha
Zinc	161g/ha
Iron	2911g/ha
Copper	37g/ha
Molybdenum	5g/ha
<i>Source: Hutchinsons.</i>	

Nutrient building with cover crops

Trials at an Essex farm are shedding more light on the benefits that cover crops can bring to soil health, the environment, and nutrition in following cash crops.

The field-scale demonstration at Ben and Paula Twinn's JRT Farm, Cobbs Farm, near Pebmarsh, has been jointly organised by a agronomy firm Farmacy, and sponsors Essex and Suffolk Water, to quantify the impact of five multi-species cover crops grown in a 'real-world' situation.

"We've dabbled with cover crops for a couple of years, usually as a single species mix such as mustard or game cover, but there have been variable results," says Ben. "Slugs are a particular concern on our heavy land, as we've seen real problems with them in the past after a two-year leguminous mix.

"But despite that, we're keen to see how we can make cover crops work for us, especially with the funding now available through the Sustainable Farming Incentive (SFI), which is something we're looking at joining now that we're on the cusp of coming out of a Higher Level Stewardship scheme."

A 14ha field of predominantly heavy clay was chosen for the demonstration, which had previously been a winter wheat crop, and is due to go into Mulika spring wheat in 2024. Straw was baled ahead of a single pass with a Väderstad Carrier after harvest, then five Hutchinsons cover crop mixes — MaxiN, MaxiCover, MaxiRooter, MaxiGraze and MaxiSpectrum — were sown using the farm's 6m Einbock drill on 27 August 2023.

A detailed soil test was conducted before sowing to provide a baseline of core soil properties, against which any improvements could be measured. It also allowed Ben and Paula to assess the soil's 'biological signature' using a phospholipid fatty acid (PLFA) test and compare results with another field that has been in a clover mix for the past two years.

"The cover crops were sown later than is ideal, but that reflects the reality for many growers in a season like 2023 and is all part of the reason why it's important to test things in a 'real-world' situation," says Farmacy agronomist, Jim Woodward.

Cover crops took a while to get going in the hot, dry conditions experienced soon after drilling during early September, but once rain came, all mixes quickly put on large amounts of biomass, he says. Assessments show the average above ground biomass across all five mixes more than doubled in a month, increasing from 14.32t/ha on 18 October to 38.21t/ha by mid-November, with the MaxiRooter and

MaxiCover mixes leading the way.

"That's a great amount of growth that's delivering a lot of benefits both above and below ground. It's subjective, but already soil appears to be drier, easier to travel on, and slightly more friable where there's a diversity of cover crop roots in the ground. There's plenty of earthworm activity too.

"All the time there's green cover growing, plants are photosynthesising and pushing sugars into the soil to feed the biology, while capturing and storing carbon and preventing valuable nutrients from being lost from the soil.

"But on heavy land like this, we have to strike the right balance," adds Jim. "Building biomass is great, but we still have to let air in to help dry the surface out, and be able to manage that cover when it's time to drill the following crop."

Tissue analysis of samples collected during November offers an insight into the nutritional content of each cover crop mix. In terms of nitrogen, the highest level was in the MaxiN mix, which has been tailored to maximise nitrogen fixation with a high ratio of legumes. In total, MaxiN contained 291kgN/ha, however levels in other mixes ranged from 134-182kgN/ha.

"A proportion of that nitrogen would have been in the soil already, but if we weren't capturing it in the cover crop, then there's a risk that some of it would have been leached out of the soil into watercourses during wet weather," says Stephen Derbyshire from Essex and Suffolk Water.

The same applies to other nutrients, such as phosphate, which can also pose significant water quality concerns, he notes. "Keeping nutrients in the field is a win-win for both farmers and water companies."

For Ben and Jim, the big question is knowing what proportion of those nutrients will be available to the following spring wheat crop, and how quickly plants will be able to access those nutrients.

Much of this will depend on how and when the cover is terminated, the biological activity of the soil, and how effective it can break down and cycle nutrients, says Jim.

"Our Gold test shows the soil here has quite a high pH (7.3), which makes it more bacterially dominant. Having bacteria that are capable of solubilising inorganic phosphorus from insoluble compounds is important, but there has to be a balance with the levels of fungi, notably arbuscular mycorrhizal fungi, which help plants to take up nutrients."

Ben has been pleased by the levels of nutrients, particularly nitrogen in the cover crops, and hopes this may allow him to make some fertiliser savings in the following spring wheat. As



A field-scale demonstration at Cobbs Farm near Pebmarsh has looked to quantify the impact of five multi-species cover crops grown in a 'real-world' situation.



Jim Woodward and Stephen Derbyshire have both been involved with the cover crop trials to establish how they can benefit soils and prevent leaching.



One of the anecdotal benefits of planting cover crops has been the amount of earthworm activity.

part of the trial he plans to reduce nitrogen rates on part of the field by around 30kgN/ha from the standard 250kgN/ha to see if there's any difference in crop performance.

Jim will also monitor the establishment and growth of the spring wheat and conduct tissue analysis to identify any benefits from the nutrients released from the cover crop material.

"We know that generally, soils in the UK have been degrading in terms of organic matter, so we must stop that decline and build levels back up," he adds. "Growing cover crops is one of the few opportunities to do that."