

Looking at lock up



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PHIL HAYGARTH

Phosphate is fundamental to crop performance, yet the majority of it never reaches the plant. Why does so much become locked up, and what can growers do about it? CPM finds out more.

By Charlotte Cunningham

If you stand at the edge of almost any arable field in the UK and consider the nutrients beneath your boots, one uncomfortable truth quickly emerges. For all the money, time and expertise invested in fertiliser programmes, some of what’s applied never reaches the crop – and nowhere is this more evident than with phosphorus.

“Imagine there’s 100% phosphorus in the soil,” proposes Professor Phil Haygarth, professor of soil and water science at Lancaster University. “If you look at what’s actually available to the crop, it’s typically only 3-5%. That means around 90-95% is effectively locked up.”

It’s a statistic that gives pause for thought. Phosphate remains fundamental to crop establishment, resilience and yield potential, yet the overwhelming majority of it is sitting out of reach, bound to soil particles and unavailable to developing roots, at a time when growers are under increasing pressure to improve efficiency, reduce waste and justify every input.

Phosphorus has underpinned modern food production for decades, with mining and refining of rock phosphate transforming global agriculture and allowing soils to be supplemented

far beyond their natural fertility. “It’s done amazing things for humanity,” says Phil. “It has supported modern farming systems and food security.”

But its importance goes far deeper than yield alone, he continues. “It’s part of DNA, part of seed germination, part of resilience – it’s part of the fibre of crop production.”

In other words, phosphorus is woven into almost every biological process that drives crop performance, meaning that when access is limited, the effects may not always be dramatic or immediately visible, but they are persistent.

Over time, restricted availability can quietly undermine rooting, canopy development and crop resilience, reducing a plant’s ability to cope with stress later in the season.

Part of the problem lies in how phosphate behaves once it enters the soil, because unlike nitrogen or potassium, it doesn’t move freely through the profile. Instead, it reacts rapidly with surrounding minerals, forming compounds that roots struggle to access, explains Phil.

The mobility of phosphorus is sensitive to soil pH, and it also tends to get locked up in precipitates bound with calcium, aluminium and iron. “It

locks itself up, and once it’s locked up, it’s not very mobile at all.”

As a result, many soils become rich in total phosphorus but poor in available phosphorus, creating a growing disconnect between what’s present in the soil and what crops can realistically use.

Over years of application, ‘legacy’ reserves build up in inaccessible forms, while fresh fertiliser continues to be applied to meet immediate crop demand, reinforcing what Phil describes as an inherently inefficient system.

The consequences of this inefficiency are felt most keenly in the early weeks of crop growth, when phosphorus plays a central role in energy transfer and cell division, helping seedlings establish roots and build structural strength.

“Phosphate is primarily about rooting,”



A ‘lazy’ nutrient?

Part of the challenge is phosphate’s fundamental lack of mobility in soil, suggests Origin’s Toby Ward.

explains Toby Ward, nutrition agronomist with Origin Soil Nutrition. "That's why it's used so widely in starter fertilisers."

Yet early spring is often when availability is lowest, because cold soils slow microbial activity and nutrient cycling, limiting the biological processes that might otherwise release phosphorus from bound forms – while young plants are simultaneously restricted by small, shallow root systems.

"You often see it in maize," says Toby. "Purple leaves, stunted growth. Then, as soils warm up, the crop grows away."

Cereals, oilseeds and vegetable crops can show similar symptoms, and while the effects are often subtle, they can influence tillering, rooting depth and canopy development throughout the season.

Research suggests young plants can devote up to 70% of their early energy to nutrient acquisition, meaning when phosphate is distant or inaccessible, that energy is diverted away from growth.

Part of the challenge is phosphate's fundamental lack of mobility in soil, suggests Toby. "It's a lazy nutrient – it doesn't move very far."

Once applied, it remains largely where it lands, which makes placement one of the most powerful tools available to growers seeking to improve uptake, he believes.

Broadcast fertiliser spreads phosphorus thinly across the soil surface, increasing the distance roots must travel to access it, while banding or placing nutrients close to seed concentrates supply where demand is highest, explains Toby. "If you broadcast it, you might not see the early uptake you're hoping for; placement makes a huge difference."

This is particularly relevant in reduced tillage systems, where stratification can develop and surface-applied phosphate may remain beyond

the reach of deeper roots.

Toby adds that while growers have no shortage of phosphate sources, each behaves differently once entering the soil system, so considering this is vital to success.

Triple superphosphate (TSP) remains the dominant straight P fertiliser, while diammonium phosphate (DAP) is widely used in compound formulations. "DAP is popular for seedbed applications because it delivers nitrogen and phosphate together," says Toby.

Organic sources complicate the picture further, as rock phosphates release nutrients slowly through chemical and biological processes, while manures and slurries contribute significant phosphorus in variable forms.

"People sometimes forget how much P they're applying through recycled organic manures; it all adds up," raises Phil.

As rotations diversify and nutrient sources multiply, understanding these interactions becomes increasingly important, he continues.

He believes that improving phosphate use is not only an agronomic issue, but also a strategic one, particularly as global rock phosphate reserves are finite. This is because while estimates vary, most suggest economically viable supplies may last only a few hundred years. "In geological terms, that's nothing, so we have to be careful," stresses Phil.

At the same time, excessive soil phosphorus increases environmental risk, with runoff and erosion transporting bound phosphate into rivers and lakes and contributing to eutrophication. "If it builds up in soil, there's a greater risk that it'll eventually end up in water," warns Phil.

This places growers in a difficult position, balancing the desire for productivity



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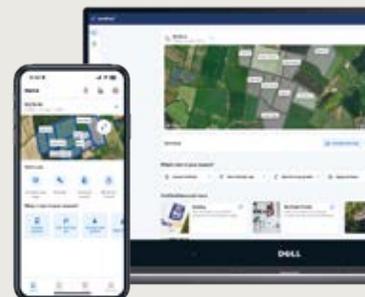


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Case study: Rix Farms, Essex

Getting to the root of the problem

Alongside better placement and planning, product technology is being used to address fixation directly.

Origin Enhanced Phosphate (OEP) is one example, using a carbohydrate-based polymer coating to protect soluble phosphate as it dissolves.

“The coating has a high cation exchange capacity,” explains Toby Ward. “It attracts iron, aluminium, calcium and magnesium, so they bind to the polymer instead of the phosphate.”

By intercepting antagonistic ions, the coating prolongs nutrient availability in the root zone. “It’s biodegradable, working with soil processes rather than against them,” he adds.

Such technologies aren’t being presented as silver

bullets, but as part of a wider toolkit for improving efficiency – as one Essex grower has found. For Sam Rix, improving phosphate efficiency was never about cutting corners. It was about understanding where inputs were delivering value – and where they weren’t.

Based at Great Horkesley near Colchester, Rix Farms grows onions, potatoes and cereals across around 2500ha in Essex and Norfolk. The business produces approximately 26,000t of onions each year, supplying major retailers including Tesco and Marks & Spencer through its sister company, Stourgarten.

With high-output vegetable crops at the heart of the rotation, fertiliser performance is closely scrutinised. “We feed

the onions and potatoes quite hard,” explains Sam. “We use liquid fertiliser at establishment, followed by granular applications. Rates of around 1000kg/ha on potatoes and 400kg/ha on onions are fairly typical.”

However, onions present particular challenges, he says. “They’re susceptible to leaf scorch, so granular is the only safe option once the crop is growing. But, they’re also lazy rooters, so availability is critical.”

To address this, Rix Farms applies an OEP prescription blend ahead of drilling, ensuring phosphate is positioned close to developing roots during establishment. “We want that nutrient there from day one,” says Sam. “Getting establishment right sets the tone for the whole season.”

Detailed soil analysis underpins fertiliser planning across the business, helping maintain and improve indices where required. “When we switched from standard DAP to OEP in 2022, it was very much a data-led decision,” he explains.

Following advice from Origin agronomist Alan Gray, the business began trialling reduced phosphate rates on selected fields. “He suggested we could lower rates because of improved availability,” says Sam. “Anything that makes fertiliser more efficient is worth looking at.”

The results were closely monitored and the farm compared the reduced rate with its standard programme and saw no difference in establishment or crop quality. “That gave us confidence to roll it out across the acreage the following year,” notes Sam.

Since then, phosphate applications have been reduced by around 15% across the rotation. The impact of this extends beyond onions and potatoes



Root cause

Sam Rix of Rix Farms applies an OEP prescription blend ahead of drilling, ensuring phosphate is positioned close to developing roots during establishment.

– because high phosphate rates are applied to break crops, residual nutrient levels are sufficient to support following cereals. “Our wheat generally only needs nitrogen and sulphur. The phosphate is already there,” says Sam.

Regular soil testing confirms that indices are being maintained, reducing the need for corrective applications. Operational efficiency has also improved. “At very high rates, spreading becomes a logistical exercise,” he explains. “You’re constantly refilling and supporting the operator.”

Reducing application rates by 15% has increased time between refills and streamlined operations during busy periods making life easier all round, he adds.

For Sam, the move to protected phosphate reflects a broader shift in approach. “It’s about making sure what we apply is actually working,” he says. “We’re not interested in cutting back if it affects performance. But if we can use less and get the same result, that’s a win.”

With margins under pressure and sustainability rising up the agenda, that mindset is likely to become increasingly important. “It’s about making every kilo count,” he concludes.



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▶ with the need to reduce losses and avoid unnecessary accumulation, he says. “Don’t just keep applying liberal amounts – think twice, be more modest, be more strategic.”

Soil testing remains central to that strategy, and under SFI and other schemes, regular analysis is now routine. However, data alone doesn’t guarantee better decisions, comments Toby. “It’s about interpretation, not just defaulting to a standard fertiliser every year.”

Indices, pH, organic matter and texture all influence phosphate dynamics, meaning two fields with identical P indices may behave very differently in practice.

As a result, Toby says it’s important to ensure focus is shifted to matching application rate, timing and placement to specific field conditions and moving away from blanket programmes towards more responsive systems.

For many growers, phosphate management is beginning to shift from a question of how much to apply, to how well it’s working. In Phil’s terms, much of UK agriculture is still operating on a relatively small slice of



Underpinning modern food production

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the phosphorus ‘pie’, while the rest remains locked away in inaccessible forms.

Improving access to that hidden reserve – through better placement, smarter planning and improved protection – represents one of the most significant opportunities for nutrient efficiency. “Phosphorus has given us huge benefits,” concludes Phil. “Now we have to use it more wisely.” ●

Product focus: Omex refreshes Fortiflo foliar range

Alongside soil-based nutrition, many growers are also using foliar applications to support crops when root uptake is limited by cold soils, dry conditions or nutrient lock-up.

Omex has recently refreshed its Fortiflo foliar fertiliser and biostimulant range, bringing existing and newer products together under a single portfolio. The firm says the update reflects a wider focus on improving nutrient efficiency and supporting crops through periods when soil supply is constrained.

The Fortiflo range includes formulations supplying readily available major and trace elements, alongside products designed to support plant metabolism and stress tolerance. Applications are typically used to complement base fertiliser programmes at key growth stages, rather than replace soil-applied nutrition.

According to the company, the refreshed range is underpinned by ongoing field trials and on-farm validation, with an emphasis on practical performance under commercial conditions.

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