

The benefit (left) of applying fertiliser with OSR seed contrasts with seed - only sowing in this Optico picture

# PHOSPHORUS PLACEMENT UNDER FRESH SCRUTINY

Feed the plant – not the soil. That's the thrust of on-going research to learn how to use phosphorus (P) more efficiently and sustainably in arable farming. By Andrew Blake

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Fertilisers containing several nutrients, including P, were once often applied with seed during planting and so-called "combine drills" were common on farms - but the practice declined.

Renewed interest in using P fertiliser more efficiently, especially to boost early growth, has triggered two AHDB

research projects and prompted manufacturers to develop more accurate ways of applying it.

Plants need phosphorus to grow, but most of the P in soils is unavailable to them.

"So it's necessary to apply phosphate fertiliser, most of which is made from mined rock phosphate, to increase and sustain crop yields," says ADAS

research scientist Alison Rollett. Current UK production systems aim to keep soil P

reserves high by applying highly water-soluble fertilisers, she notes. "But this is very inefficient and increasingly costly, and is depleting the finite non-renewable global reserves of rock phosphate."

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# Winter wheat trials

One aim of the new research is to maximise and determine the value of fresh annual fertiliser P applications in terms of crop yield and quality under various levels of soil P fertility, explains Steve Dudman of industry partner Frontier.

"Frontier are coordinating a series of tramline trials so the project can look at responses on a field scale using precision equipment," he says.

The first site – one of 20 trials intended by 2018 – was established in autumn 2014 on clay loam in Northants after assessing the farm's soil maps created by joint industry partner SOYL.

"The P indices ranged from 2 to 3. Ideally we would have liked a greater range including soils at index 0 to 1 to stretch the treatments, but we wanted to make a start on an otherwise ideal farm so we could develop a robust on-farm protocol for conducting these demanding trials," says Mr Dudman.

The four treatments, to winter wheat after peas, repeated three times across the field were: zero fertiliser, 15kg P2O5/ha placed, 70 kg P2O5/ha placed and 70 kg P2O5/ha broadcast and incorporated to 5cm. All were

in relation to soil P before we can get a full picture regarding treatment effects.

"We'll use the lessons from this first year to adjust our approach to future sites. We have four more for harvest 2016, in Northants, Cambridge, Essex and Gloucestershire.

Three have been sown with winter wheat, using either a Sprinter or a Vaderstad Rapid drill, and the fourth is scheduled for spring cropping. The soils range from clay loam to chalky sandy clay loam.

"As more trials are done, we should begin to understand on a field scale how to use fertiliser phosphate more efficiently at different soil concentrations on different soil types and in a way that can increase yields."

Small plot trials on crop nutrition struggle to achieve the 95% confidence level for the results to be statistically significant, so potentially beneficial management changes may get dismissed, notes Mr Dudman.

"Achieving reproducible results on a field scale may give us a more acceptable link between technical and economic responses. Only time will tell."

by soil processes, she adds.

"One way to overcome this is to modify the application method to circumvent the soil and allow more precise targeting of P at key times for the plant's growth and development.

"Placing it close to the seed is a well-established technique which largely ceased in recent decades

to enable faster drilling.

"Top dressing after drilling has become more common, but these surface applications pose an acute risk of P loss in run-off which can lead to water pollution.

In the first of the latest research projects, the LINK-funded Targeted-P work led by ADAS and Bangor University, ten field



Steve Dudman of industry partner Frontier

drilled with a 12m Horsch Sprinter tined seed and fertiliser drill.

"The farm's operations are all managed with an RTK system, so location of the treatments was very accurate."

The seed was sown 5cm deep across a 150mm band, and TSP\* fertiliser was placed 5cm below, allowing roots from the germinating seed to contact fresh P quickly, he explains.

"At first glance, the better response from placing 15kg/ha than from either of the larger applications looks promising, but further analysis is required

## Modify the application method

The practice has also led to a build-up of P in soils, sediments and wastes which are gradually leaking into lakes, rivers and estuaries and encouraging undesirable algal growths. Even in highly water-soluble forms fertiliser P is rapidly immobilized

trials using experimental drills and planters showed that placing P fertiliser, rather than broadcasting and incorporating it, boosted spring barley and potato yields by up to 0.4t/ha and 3t/ha respectively.

## feed the plant not the soil

That work, which ended in 2014, is being built on by the AHDB Cost Effective Phosphorus Management project, also led by ADAS.

The research could eventually help growers farm profitably at P index 1 rather than index 2 and reduce P losses to water, notes Dr Rollett. "The approach is to feed the plant not the soil."

## P with the seed in OSR

Agri's work with oilseed rape last season found that sowing

P-containing fertiliser with the seed lifted yields by up to 0.3t/ha. "Broadcasting on the surface feeds and helps weeds to grow" – David Langton, Agrii. Establishing the crop quickly



David Langton

and evenly to defend it from flea beetles is becoming increasingly important, he stresses.

"With placed fertiliser we

usually get an increase in green area index (GAI) before the onset of winter. This doesn't always increase yield, but that isn't necessarily the aim with winter rape – reliable establishment of a robust crop is key."

The replicated trials on chalk soil used various combine drills (Amazon EDX, Horsch Focus, Kuhn Optima, Sumo DTS and Vaderstad Tempo) to apply 100kg/ha DAP\*\* + P Reserve with the seed. "P Reserve is a coating that prolongs the availability of the phosphate and reduces its lock-up by the soil," explains Mr Langton.

The placed fertiliser delivered 18kg/ha N plus 46kg/ha P2O5 and led to GAI increases averaging 0.35 by mid-October.

Placing is particularly important where the crop is sown in wide rows, says Mr Langton. "Fertiliser will be used only if it's close enough to the developing plant."

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# GROWING RANGE OF

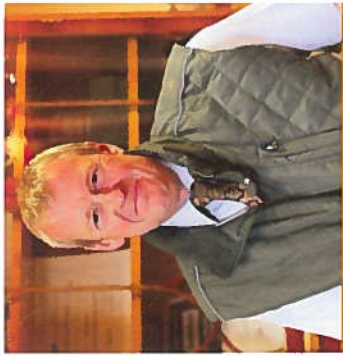
## 1. Seed row banding

Phosphorus is notoriously immobile and not easily reached by emerging seedlings, says Simon Brown of Amazone. "So adding a band into the seed row will pay dividends."

Accelerating seedling development by using starter nutrients, particularly P and nitrogen in the autumn on oilseed rape, improves root development and strengthens crops against diseases and pests helping them compete against weeds, he maintains.

Fertilising and drilling simultaneously can also save time; but the equipment is more expensive and the machines' smaller hoppers will affect filling practices and turnaround times, he admits.

"But the improved early development can cut the cost of crop protection, and the technique is ideal for winter



Simon Brown



oilseed rape using DAP or MAP\*\*\*. For winter cereals the restriction on autumn nitrogen means only TSP is appropriate."

Amazone offers two types of combined seed and fertiliser drills – SingleShoot and

DoubleShoot, explains Mr Brown.

"The former, available on the firm's C range such as the Cirrus C and Cayena C drills, applies seed and fertiliser together down the same spout making them ideal for autumn cereals and rape establishment."

DoubleShoot, as in firm's CC range such as the AD-P CC combined drill combination, or the ED and EDX precision maize drills which have proved very effective for rape seeding, places the seed and fertiliser into separate soil zones no closer than 2cm," he explains.

"Depending on soil moisture levels, care needs to be taken not to get some fertilisers too close to the seed. High nitrogen concentrations in a dry time close to the seed can affect germination, and the smaller the seed the greater the risk. Where there's a lack of moisture then the use of TSP rather than an ammonium-based fertiliser should be considered."

used in combination with grain and fertiliser-spec drills, plus the latest Kultitrip strip tillage machines.

"All elements of the Kultitrip are fully adjustable, including the fertiliser placement tube which is not fixed to the low disturbance loosening leg," says Mr Burt.

"This patented feature lets growers choose the fertiliser placement depth independently of the loosening leg."

"And with development of an optional wider leg in combination with a larger diameter tube, Kultitrip can also handle slurries and liquid fertilisers."

## 2. Independently adjustable fertiliser placement



Kverneland's approach to P placement centres mainly on the DF1 front fertiliser hopper, notes Kverneland's Adam Burt.



Adam Burt

The 1500-litre capacity DF1 with integral metering can be

# PLACEMENT TACKLE

## 3. Newcomer applies seed and fertiliser at different depths



James Woolway

European market in a very short time," says Opico's James Woolway.

Sky's EasyDrill has two distinct air delivery circuits allowing operators to apply seed and fertiliser at separate depths.

"Eighty per cent of fertiliser efficiency is due to proper placement," says Sky's Christophe Decarville.

"Phosphorus is the least mobile element. To be available it must be located less than 2mm away from a root, so placement with the seed is the most efficient approach."

Concentrating P with the seed makes economic and environmental sense, he says.

"You don't use too much of a natural resource – there's a finite

quantity on earth – and you don't lose any in surface water."

Phosphorus availability is sensitive to soil moisture, temperature and pH, and placing P really close to the roots helps counter both those problems, adds Mr Decarville.



## 4. A liquid solution

Cultivating Solutions' approach to placement is via liquids.

The firm's Richard Scholes says it is widely understood that P cannot travel in the soil profile more than a few millimetres a year. "Therefore broadcast applications of granular P cannot be guaranteed to be available to recently sown plants.

"Broadcast application is completely random, and it's pot luck whether a granule lands close to a plant. This isn't the way to guarantee nutrient availability from day one. Indeed it could be argued that plants on low P index soils may struggle to get hold of any P at all during the season."



Richard Scholes



The firm offers two systems for applying liquid fertilisers while drilling. "One is a stream jet method whereby the streams are aligned to the seed rows as they are sown," he explains. "The second is a form of injection in which nutrient is delivered alongside the seed through the couler.

"Some people advise placing the nutrients under the seed, but we don't subscribe to that. If the idea is that the plant roots grow down to the nutrient below, then what happens after that? We want crops to develop the maximum root mass by scavenging the whole soil profile for nutrients and water throughout the season."