

Establishing potential

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Technical Better biostimulation

As the focus turns to getting 2022 crops in the ground, *CPM* takes a look at how learnings from Frontier's BioPlan programme could help boost new crop establishment over the coming months.

By Charlotte Cunningham

Just as harvest 2021 begins to draw to an end, many will already be thinking about preparing for next season's crops.

And though much is unknown about how this new season will pan out, laying the foundations is key to bringing a fruitful, profitable crop through to harvest, says Dr Paul Fogg, Frontier's crop production technical lead. "Over the autumn months, it's all about perfecting that foundation phase, which takes winter cropping from seed to germination and emergence.

"What we do and achieve in those first six months determines the platform we have to build on come the spring."

This starts with the basics, adds Paul. "There has to be a focus on good establishment. Here we're talking about factors like seedbeds, soil condition and any drainage that needs rectifying before you

even think about getting a drill out. It's also important to think about the quality of your seed — there's no point trying to push yield and performance with 'icing on the cake' type products if you're starting with a poor-quality seed."

Realistic expectations

Paul notes that it's important to think about what you're trying to achieve. "Ask yourself questions like, what is a realistic establishment percentage? And what do you hope to have in terms of plants per m² as you come out of the winter?"

"Think about this in relation to elements like the weather conditions at the time, soil type, establishment technique, seed rate, sowing depth etc."

Only when the foundations are correct is it possible to start thinking about what else could be brought in to push the performance of high potential crops, he adds.

"Biostimulants have a role to play here. When used correctly, they have the potential to help to optimise that crucial establishment stage."

But what does this mean in practical terms? According to Paul, the advantage biostimulants can have during the autumn comes down to their ability to increase rooting.

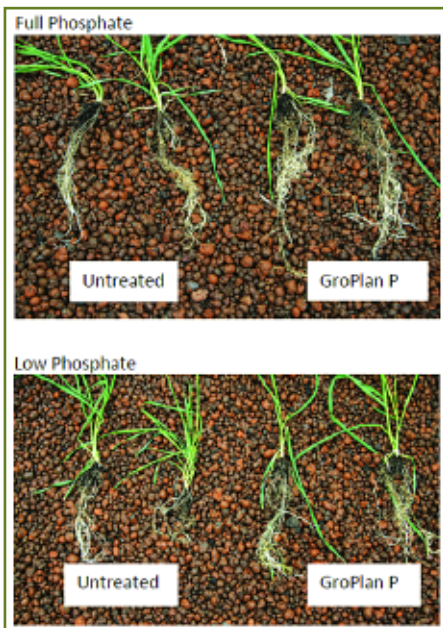
Jim Stotzka, Frontier's lead on sustainability, adds that this functionality can be beneficial in helping crops reach their genetic potential. "By allowing a crop to maximise its

root mass and therefore exploit water acquisition and nutrient assimilation, we're setting the crop up well. If you fail to do this, that genetic potential starts to chip away bit by bit."

Looking at the tools available, Paul says seed treatments are a key vehicle for the early application of biostimulant technology and he believes the biostimulants, phosphite and R100, will be a key aid during the autumn months. "The goal at this stage should be to increase rooting as much as possible. Firstly, we're thinking about phosphite-based seed treatments which can be used to speed up establishment and increase root biomass. Seed treatments get the technology exactly where you want it — within that rhizosphere — and ultimately gives you a better chance of triggering



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a genetic response from the plant.

Paul believes a phosphite seed treatment is best followed by a foliar application.

Key autumn offerings under BioPlan

Product	Biostimulant	What does it do?
Propser ST	Phosphite	A phosphite-based seed treatment designed to speed up establishment and increase root biomass.
Gro-Plan P	Foliar phosphite	Suitable for use on a range of crops, Gro-Plan P can be used alone, or in a tank mix with Cearum.
Cearum	R100	Designed for use on cereals, R100 contains a balanced ratio of manganese, copper and zinc, combined with the R100. It supports early plant establishment, tiller production and maximises photosynthesis for the maintenance of healthy green leaves.

Microbial potential

As well as non-microbial biostimulants, microbial sources could be beneficial in the autumn.

The benefits of such sources were explained in detail in the last instalment of Better biostimulation. However, there are some challenges which Frontier is looking to resolve before including these types of products in the BioPlan programme. "Formulation is the first hurdle, and here we're thinking about the stability of the inoculum as well as factors including shelf life, application through sprayers and how it behaves in tank mixes, for example," says Jim.

"Some species are more robust, however. This includes *Bacillus* species which form endospores that act as additional inoculum and are very hardy. Endospores are formed in the mother cell and are eventually released as free spores. They are proven to be more durable and can remain so for

extremely long time and is a key component in one of our OSR seed treatments.

"Once there is a formulation that's workable, we have to look at whether or not it can go through a standard crop sprayer and maintain its efficacy."

Quality is another hurdle to overcome, he adds. "The most important considerations here are efficacy and purity which could be a problem with the 'home brew' style products on the market.

"Instead, we'd be looking to support a product which has been produced in a controlled environment, like a lab, and is quality checked which often requires regular DNA protocols as well as other strict laboratory protocols."

And then there are environmental factors to consider. "Microbial biostimulants have to be able to compete with existing microbiome without

"Depending on the form of phosphite, it's readily absorbed and translocates down towards the root, again boosting and encouraging that root growth."

This has been proven in in-vitro work, adds Jim. "We know from the trials that we get better root mass, and more quickly, where phosphite is used. We looked at this under both heat and drought stress trial conditions and saw a better crop response, in terms of recovery, where a crop had been treated with phosphite."

Delving a bit deeper into the science, Ranjan Swarup from the School of Biosciences at the University of Nottingham has been investigating the role of phosphites in plant development.

He specifically looked into whether phosphites have biostimulant properties and used a range of phosphite-based products in more than 10 replicated trials.

A variety of assessment techniques were utilised — including 2D root phenotyping and x-ray CT imaging — and theories were tested in both proof-of-concept work and in the field. The results were summarised as followed:



Biostimulants can be a helpful aid to ensure the crop's true genetic potential is reached.

- Phosphite exhibited a root promotive effect in winter wheat; maize; linseed; onions; peas; beans; oilseed rape; sweet peas; sugar beet and potatoes.
- A foliar application of phosphite enhances root growth, typically increasing biomass by 30%.
- Phosphite treatment in wheat enhances root system architecture as revealed by x-ray CT imaging.
- Phosphite treatment improves nutrient and water use efficiency.
- The effect of phosphite appears to be more pronounced under mild stress (restricted water condition or under reduced nutrient strength).
- Foliar application of phosphite typically improves carbon assimilation and leaf water use efficiency (carbon gained per unit water loss). ▶

making permanent changes, and they have to be able to survive in a variety of conditions."

So how can these challenges be met? It all comes down to some very stringent quality checks, explains Jim. "Firstly, it's important to identify the right microbes for specific crops and ensure that application is possible through standard farm machinery," explains Jim. "It's also essential to identify optimum application timing to get the best out of the microbe and ensure that bacteria can compete in a wide range of pH and soil conditions.

"Then of course, there is health and safety to think about, with manufacturers responsible for ensuring organisms are safe to release.

"We only introduce new microbial products where we really believe there's a value to be gained by farmers from incorporating them."



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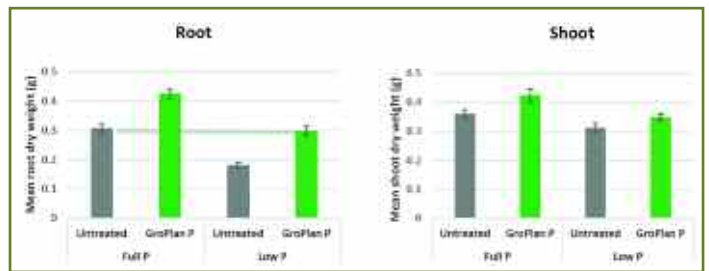
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Studies have shown improved root and shoot weight with GroPlan P.

► • In collaboration with Kiel University (Germany), it was proved that phosphite treatment results in increase in nitrate reductase — a key enzyme in N assimilation. Under the BioPlan programme, and in conjunction with IntraCrop, Frontier has two phosphite products. The first is Prosper ST, a phosphite-based seed treatment, and the second is GroPlan P — a foliar phosphite.

Paul says that the university has also been able to prove and confirm the efficacy of GroPlan P — even in a low phosphate environment.

Looking at the process, wheat seedlings were grown in hydroleca beads. Control plants were maintained with an optimal nutrition solution, while phosphate was restricted to just 10% of the control in the other half.

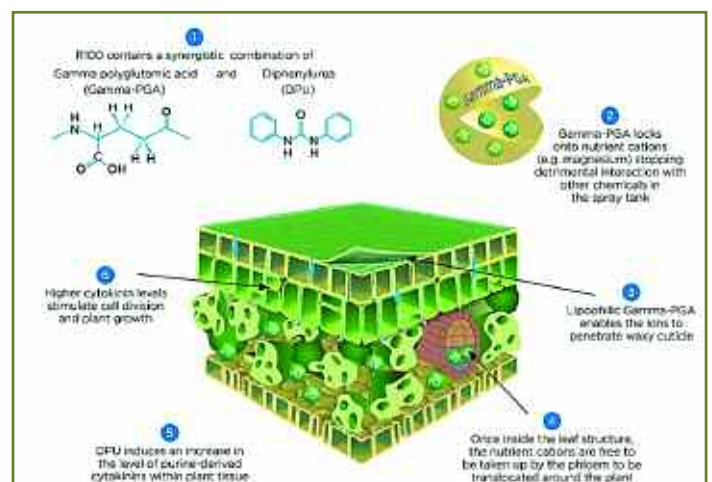
GroPlan P at 0.75 l/ha was applied at BBCH14 to both the control and low phosphate treatments. The wheat plants were then assessed 27 days after application.

“Plants treated with GroPlan P had a visibly larger root system than control plants — root dry weight was increased by 38%,” he explains.

Perhaps most significantly, in the untreated low phosphate plants the root mass was almost halved — but those treated with GroPlan P had the same root weight as untreated control plants grown in a full phosphate solution.

GroPlan P is a foliar applied biostimulant that can be used either as a single application or in a programme. Through the work within BioPlan, Paul says the best response has been seen when phosphite is delivered via a ‘little and often approach’. “In a perfect world, we’d advise a little phosphite on the seed to start with, followed up with phosphite applications around GS13-14 and then ideally get another application in the spring, pre stem extension.

“Obviously things don’t always go as planned, and if a seed treatment isn’t possible, we’ve seen that there are still benefits



R100 is a novel biostimulant technology which can be described as a nutrient transport mechanism. The diagram above illustrates how it works.

from just doing two foliar applications — ideally autumn and early spring.”

However, he stresses that it's crucial to remember that phosphite doesn't replace phosphate and it must be used in combination with a phosphate fertiliser to ensure a readily available source of P to the crop.

Introducing R100

The use and field performance of biostimulants are inextricably linked with appropriate nutrition, both macro and micro, says Paul. And he reckons that growers may also find benefits from using a novel biostimulant named R100 this autumn — but what exactly is it?

“R100 is a biostimulant technology which can be described as a nutrient transport mechanism,” explains Jim. “It contains two products — diphenylurea (DPU) and gamma polyglutamic acid (gamma-PGA) and its role and purpose is to increase the uptake and utilisation of cationic nutrients and stimulate cytokinin production which encourages plant growth. It does this by binding to cations and transporting them into the plant where they are released and utilised.

“It also encourages magnesium assimilation, which is critical for photosynthesis”.

Frontier has a range of products containing R100, including RapidMan (manganese nitrate), Proleaf manganese sulphate S-R100, Magistrate, Program and Cearum.

Likely to be of particular interest over the coming months, Cearum contains a combination of manganese, copper, zinc — and of course, R100 — and Jim says including this as part of a programmed approach in the autumn can help to encourage tillering and maximise that all important photosynthesis. “We know from proof of concept and trial work that a little bit of Cearum in the autumn can increase the uptake of cation micronutrients — it just helps to give that little bit of extra nutrition into the plant in those early stages.”

Paul adds that it's the manganese component which will be really beneficial in the autumn.

With margins often tight and growers needing to be able to justify every penny spent, quantifying an exact return on investment with biostimulants can be a challenge. However, Jim says it helps to think of them as an investment in crop potential and a core element of a strategic, programmed approach. “Really it's an investment in that potential, and as mentioned earlier, if the basics aren't right then the potential is lower, so the impact biostimulants can have may also be less than anticipated.

“However, where good plant genetics are used, high quality seedbeds are created and conditions are optimum, for example, biostimulants can be a helpful aid to ensure the crop's true potential can be achieved.” ■

Better biostimulation

As biostimulants are set to play an increasing role in crop production, it's important to separate the good from the not so effective.

This is what Frontier aims to do through its BioPlan programme. The Better biostimulation series will explore in more detail both the fundamentals of biostimulants and how to get the best from the

Frontier range in the field.

CPM would like to thank Frontier for sponsoring the series and allowing privileged access to its staff and materials to put it together.

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