Breaking down biostimulants

Biostimulants

The increase in biostimulants available on the market has given farmers and agronomists much more choice while delivering exciting new technology, however, the number of products on offer can be confusing. *CPM* investigates whether the market can be broken down to create clarity.

By Will Charlton

It's possible to classify biostimulants according to their mode of action, much like what's done with plant protection products. So could this help farmers better understand their benefits and build a mix-and-match programme according to their requirements?

The term biostimulant first emerged from scientists like Professor Patrick Du Jardin in the 1990s, says Francis Dodds, editorial director at Burleigh Dodds Science Publishing, which publishes a biostimulant guide edited by five experts: *Biostimulants for Sustainable Crop Production*.

"For a while, there were quite a lot of different terms used such as plant growth enhancers or plant probiotics," continues Francis. "Biostimulants are a broad and eclectic group of materials that have no obvious relationship with each other but can be defined as biostimulants because they perform the same functions."

Classification model

According to Francis, the mode of action is perhaps the easiest way for farmers to understand and classify them. He says these can be defined as improved nutrient use efficiency, tolerance to abiotic stress and resistance to biotic threats.

"Research suggests there are various mechanisms by which increased nutrient use efficiency occurs. One is root foraging which is the way particular biostimulants promote the growth of root hairs and root numbers by stimulating plant hormones that regulate their growth.

"This is what humic substances tend to do. You can see images of root hairs and once you add humic substances, you see dramatic improvements in root biomass," says Francis.

Biostimulants can potentially protect against abiotic stress in three different ways: defence primers reinforcing plant defences before stress, rescuers acting during stress, and restorers helping the plant to recover from stress.

"For example, seaweed extracts work through a hormonal priming mechanism which prepares plants better when stress occurs," comments Francis.

> *"Biostimulants are a broad and eclectic group of materials that have no obvious relationship with each other."*

He says biostimulants are used as primers to reinforce a plant's defences, rescuers during stress, and restorers to help a plant to recover from stress when protecting from abiotic threats.

"Microbial biostimulants, in particular plant growth-promoting rhizobacteria, can help to do this by competing with pathogens for nutrients in the soil; if they outcompete them, they suppress them. They also seem to generate antibiotic compounds as a defence mechanism themselves.

"Because they have such an extraordinary symbiotic relationship with the plant, they seem to be able to generate signalling peptides that stimulate the plant's resistance response to attack," explains Francis.

The laboratory and controlled environment studies that academics will typically use to identify and track modes of action are all very well, says Francis. However, these results don't always translate into the field.

He believes we're at the stage where ▸

Guy Peters sees a role for Encera in high yield potential crops where there's a benefit from additional nitrogen.

▸ more field trials and long-term commercial use of biostimulants are required to build up the evidence base for their use.

"In selecting a bioprotectant product, I would advise looking for products backed by a combination of laboratory and controlled-environment trials, as well as field studies. Ideally products should also be supported by independent trials," adds Francis.

Improved nutrient use efficiency

With AHDB international benchmarking indicating the UK has the highest nitrogen fertiliser costs per hectare of any country participating in the survey, it's unsurprising that many farmers are looking for solutions to improve nutrient use efficiency.

A range of biostimulants, also known as biofertilisers, now exist, claiming this as a mode of action. One of the latest to arrive in the UK market is Encera which has been brought to market by Azotic Technologies.

This was developed out of a research project at the University of Nottingham where scientists discovered how Gluconocetobacter diazotrophicus (Gd) colonises cells in sugar cane plants and then fixes nitrogen which it provides to the plant in exchange for sugars.

ProCam agronomist Guy Peters advises predominantly on mixed farms in Devon and west Dorset. Last season, he used Encera on maize crops, tank-mixing when spraying post-emergence herbicides.

Overall, he's been impressed with Encera with treated crops performing well. Guy has also found it to be compatible with herbicides without causing crop damage.

He explains that the RB209 guidelines for maize are more complicated than cereals, but in essence, the limit is 150kgN/ha on a soil nitrogen supply (SNS) index of 0. "It's not an exact science," he says.

"Every field gets a different amount of muck and slurry and winter rainfall will be variable. We also have to account for the field's history; how much muck and slurry has it had in the last ten years?

"Unlike cereals, we don't have a calculation to add extra nitrogen to account for predicted yields greater than 40t/ha. We believe maize crops with a yield potential approaching 70t/ha would benefit from higher nitrogen rates, so Encera fits nicely here by utilising nitrogen more effectively and not breaching RB209 recommendations. If in doubt, always consult with a FACTS-qualified agronomist," stresses Guy.

Anecdotal reports from agronomists on Encera's performance have been backed up by trials ProCam has conducted on maize in 2022 and 2023. When Encera was added to the farm standard nitrogen programme, which was farmyard manure, they found it increased both fresh and dry matter yield.

Encera returned consistent results across the two years by providing an additional 3.5% dry matter yield in both seasons. ProCam technical development manager Rob Adamson believes this shows how Encera is efficient and consistent in delivering nitrogen to the yield-forming components of the crop.

Tolerance to abiotic stress

Whether there's too much rainfall or not enough, overcoming abiotic stress is becoming an increasing priority for farmers due to climate change. To help crops to thrive in changeable conditions, many are turning to biostimulants with tolerance to abiotic stress as a mode of action.

"Optimising plant health from day one by using a proven biostimulant seed treatment to target seeds rather than treating plants, is the number one thing growers can do to achieve a more resilient start, both operationally and economically, and to protect genetic yield potential," explains Stuart Sutherland, technical manager at Interagro.

"Recent seasons have proven just how unpredictable the weather can be which limits everything from sowing to spraying. So by treating the seed, growers are able to take action before they even set foot in the field."

Among the offers on the market is Newton — a biostimulant seed treatment from Interagro which combines peptides that stimulate plants to thrive.

Andy Baird dressed all of his oats with Newton for the first time this season and despite a winter from hell, he says the whole 29ha field looks fantastically well.

"By managing the balance of growth-promoting hormones versus growth-inhibiting hormones, Newton triggers faster germination and emergence, signalling enhanced root and shoot growth, and plant defence systems.

"With proven abilities in the field, Newton not only ensures vigorous crop establishment, but it also helps to build stronger, healthier, more resilient plants that are less dependent on synthetic inputs," adds Stuart.

Embracing the benefits of Newton is third-generation farmer Andy Baird, managing partner at Kirkness Farm on the south side of Loch Leven. He farms 162ha of turf and arable with cropping down to winter oilseed rape, a winter oat seed crop for Alexander Harley Seeds, and high-nitrogen spring barley variety Soccer.

"We had all of our winter oats dressed with Newton for the first time this season and despite the winter from hell with horrific rainfall since October, and without any warmth, the whole 29ha field looks fantastically well," says Andy.

"The crop has rooted amazingly — the best I've ever seen in all the time we've been growing oats. It's thrived despite the difficult conditions with zero yellow patches in the field. So much so that my neighbours have commented on how well the crop looks.

"Farming is a cruel business if we get timings wrong and the crop doesn't perform as you'd expect. Well sown is half grown, and for me, Newton ticks this box," he explains.

Looking at the other crops in the rotation, local soils were just becoming ready for April spring barley sowing in the third week of the month.

"The sweet spot for drilling in Scotland is the first, second, and third week of April. We're starting the third week of April [at the ▸

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From what Antony Wade has seen, the disease control from Iodus is at least as good as other multi-sites available on the market.

▸ time of interview] and I know with absolute certainty that some spring barley crops in Scotland will be drilled in May, which we can get away with up here because of the longer day length compared with central England," adds Andy.

"The point is, time is running on, and pressure is on to get crops established well so for me, Newton is a no-brainer. Spring barley is only in the ground for 120 days so every day counts. Evidence shows Newton helps crops to emerge two days faster which is a vital benefit."

Andy believes the weather is his business partner. "Sometimes it's a great partner, but at other times it can really let you down. In farming, we have to be able to take risk out of the system and this is where Newton is a really valuable insurance. It gives peace of mind that you've done your best for the seed and establishing it in whatever circumstances present themselves."

Resistance to biotic threats

Recently, a new type of crop protection product has emerged. These are plant health elicitors which work by stimulating the plant's own defence mechanisms before an infection has taken place. Elicitors are biostimulants but are more commonly known as biopesticides – they improve resistance to biotic threats as their mode of action.

The most well-known elicitor is Iodus which contains laminarin. "Laminarin is a remarkable mix of polysaccharides extracted from brown algae," says Stuart Jackson, head of technical services at UPL UK. "It's the subject of much biomedical research as a candidate for cancer immunotherapy and its healing properties.

"In plants, it mimics the degraded cellular material released from a fungal attack which activates nearby cells' defence systems. Applying Iodus before a fungal pathogen attacks the plant prepares it for when an actual infection occurs."

A growing number of agronomists are using Iodus at T0 and this is especially true in the West of England where the septoria pressure tends to be higher than in other parts of the country. Antony Wade, Agrovista technical manager for the West, has been using it for several years.

"I've tended to use it at T0 on my stronger varieties for disease resistance, such as KWS Extase, KWS Palladium, LG Typhoon and Champion," says Antony. "These varieties don't tend to have other disease worries (like yellow rust); we're using it to support the disease resistance of the variety.

"Where to use Iodus, depending on the variety, is a topic of conversation. I know from talking to other agronomists that some of them have taken a different approach and are using it on their weaker varieties; we're still getting to know how to use the product.

"From what I've seen, the disease control from Iodus is at least as good as the other multi-sites available on the market."

T0 comes at a time when farmers could also be looking to apply herbicides, trace elements and plant growth regulators. Although big tank mixes at this time aren't recommended, the situation can force the hand of farmers, so tank mix compatibility and a formulation that is delicate with the crop are important.

"If you have to do spring grassweed control, it's one of the products that you can include with mesosulfuron herbicides like Horus (mesosulfuron+ iodosulfuron). It's a relatively benign product, so I wouldn't expect it to cause an issue, which is another benefit of it in the T0 slot," concludes Antony.

Combining modes of action

Combining multiple modes of action in a programmed approach to aid the crop in different conditions is the next step for many advocates of biostimulants.

Russell McKenzie farms 160ha in Cambridgeshire alongside a consultancy business and has evolved his approach to biostimulants during the years. He uses his understanding of their mode of action to mix and match his approach according to the situation his crops face.

"Going back to 2012, we had a situation where roots were sat in waterlogged soils, carbohydrates were stuck in the stems, and crops ended up with green stems at harvest and dead ears," says Russell.

"Now there's a better choice of

Russell McKenzie uses his understanding of a biostimulant's mode of action to mix and match his approach according to the situation his crops face.

[biostimulant] products and you start thinking about what we could do if that situation repeats itself. There's a massive toolkit to decide what to use where.

"The challenging seasons mean you begin to build up a library of ideas about how to combat crop stress and situations that will restrict yield."

According to Russell, the biggest hurdle to overcome has been figuring out how biostimulants work and where to place them. He tends to target their use on wheat early in the spring at growth stages 30 and 31, and later, around flowering and grain fill. This way, he can influence biomass levels and grain size.

"Last season, we had a really good result with Luxor alone to boost phosphate assimilation. However this year, we used a half rate of Luxor and Calfite Extra because we wanted to encourage the roots, considering the wet weather," adds Russell.

Luxor and Calfite Extra are sold by Unium Bioscience with both increasing nutrient use efficiency. Calfite Extra is a phosphite-based product which promotes root development and phosphate utilisation whereas Luxor is a blend of nutrients, humic and fulvic acids, and pidolic acid.

At grain fill, Russell plans to use 3 ALO T6P. This acts as a signalling molecule regulating carbon metabolism, particularly when the crop's under stress.

"Later on, I'm trying to move carbohydrates up the plant and boost the bushel weights and this is where T6P helps. It also improves grain quality. This year, we're low on tillers, so maximising what we do have will be important to push yields," concludes Russell. ■