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AHDB
CEREALS & OILSEEDS

*from theory
to field*

Shedding light on biostimulants

When it comes to this murky pool of products, it can be unclear just where the benefits lie. CPM finds out about a review aiming to sort the wheat from the chaff.

By Lucy de la Pasture.

In the effort to produce high quality crops, the promises offered by biostimulant products to overcome a range of problems are extremely tempting. They’ll help plants tolerate stress, take up nutrients more efficiently, give you higher marketable yields and so on, according to those who sell them — the list of remarkable feats is endless. But knowing which ones will work and how they are affecting plants can be big problems for growers.

The degree of research behind the vast

array of products falling into this category can be anything from a promise and a prayer to a published, peer-reviewed piece of science. With the biostimulant market showing huge growth and forecast to reach a value of €1bn in 2019, AHDB Cereals and Oilseeds thought it was time to sift through the available evidence and establish some facts.

Broad range

One of the major challenges with products under the ‘biostimulants’ umbrella, is the range of product types it covers — it’s so broad, it can be confusing.

In an attempt to throw some light on the subject, AHDB asked ADAS to define the term ‘biostimulant’ properly, group them by mode of action and identify where knowledge gaps exist in an attempt to identify where further research is needed, notes AHDB’s Dr Sajjad Awan.

To complicate matters, in the UK currently there are no requirements to prove the claims made by biostimulant manufacturers. The situation’s very different in other EU countries, particularly France, Italy and Hungary, where the biostimulant



The European Commission is intending to revise regulations governing biostimulants in Jan 2018 says Sajjad Awan.

market is both buoyant and better regulated. In those countries a list of ingredients is required, as well as empirical evidence to support any claims, he explains. But the UK situation should change in 2018.

“The European Commission is intending to revise Regulation (EC) No 2003/2003 of the European Parliament (the Fertiliser Regulation), to extend its scope to

include plant biostimulants (among other materials). These regulations will come into effect in Jan 2018 and then all biostimulant sellers will have to comply with the new regulations, which is good news for levy payers,” he says.

What this means is that all biostimulant products will require evidence of efficacy for any claims made. Even after the UK leaves the European Union, these regulations will apply to products that are sold elsewhere in the EU, thus it is likely that most products produced and sold in the UK will need to fulfil them, regardless of whether the UK retains this legislation or not, he explains.

In the meantime, work to demystify the field of biostimulants is already



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underway, with the first step to clarify its definition, explains ADAS research scientist, Dr Kate Storer, who led the AHDB project.

“The term ‘biostimulant’ covers everything that can be added to the plant or soil to enhance plant growth beyond fertilisation alone, except those products that have a definite ‘pesticidal’ action. So it’s very difficult for growers and agronomists to understand which products work and which don’t, or in which situations the products work best, as there is very limited independent information available,” she notes.

Definition

After reviewing a range of definitions, the reviewers settled on the European Biostimulants Industry Council (EBIC) definition — ‘a material that contains substance(s) and/or microorganisms whose function, when applied to plants or the rhizosphere, is to stimulate natural processes to benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and/or crop quality, independent of its nutrient content.’, adding the proviso that biostimulants may affect plant growth as defined by other sources.

The next challenge was to group product types and define which natural processes they may be stimulating. “Products can be a single type or a mixture of biostimulant types so grouping the main product types (see panel below) will help growers understand what they



Kate Storer has been working to demystify the field of biostimulants, to group product types and define which natural processes they may be stimulating.

may be doing in plants,” explains Kate Storer.

Although the amount of academic literature on biostimulants has increased markedly in parallel with the growth of the biostimulant market, there’s still little research of direct relevance to growers of field-scale crops, she says.

“We looked at all the academic and grey literature available and soon realised that there just wasn’t enough information on cereals and oilseed rape, so we expanded the review to all crops to get a better idea of how different product types may affect plants.”

Biostimulant products often contain a range of product types, the most common ▶

Defining biostimulants

Group	Product type	Definition
Non-microbial	Seaweed extracts	Products that have been extracted from seaweed (e.g. <i>Ascophyllum nodosum</i> extracts)
	Humic substances	Extraction product of humus (e.g. humic or fulvic acids)
	Phosphite and other inorganic salts	Salts that do not contain carbon
	Chitin and chitosan derivatives	Chitin is an abundant natural polysaccharide. Chitosan is a deacetylated form of chitin
	Anti-transpirants	Product that reduces transpiration by plants
	Protein hydrolysates and free amino-acids	Protein hydrolysates are produced from a variety of animal and plant residues. Free amino acids are single amino acids that require no digestion
	Non-essential chemical elements	Elements that are not required by all plants but can benefit plants (e.g. Silicon)
Microbial	Complex organic materials	Broad range of products that contain material derived from the remains of organisms (e.g. plants)
	Plant growth promoting bacteria	Bacteria which benefit plant growth (e.g. <i>Bacillus/Rhizobia</i> spp.)
	Non-pathogenic fungi	A wide range of fungal species that have no direct pathogenic effect on plants (e.g. <i>Trichoderma</i> spp.)
	Arbuscular mycorrhizal fungi	Common type of endomycorrhizal fungus that forms a symbiotic association with plant roots. (e.g. <i>Rhizophagus irregularis</i>)
	Protozoa and nematodes	Protozoa are single celled rhizosphere organisms. Nematodes are non-segmented worms



Some of the microbial biostimulants help release phosphate in the soil which is often locked up so plants can't use it.

► product types are summarised in the panel on p27, though this list is not exhaustive.

When the reviewers turned their attention to efficacy and mode of action of the different product types, Kate Storer admits that as scientists are by nature sceptical until scientifically proven, they were actually surprised at the results of the work they were reviewing.

"It's an emerging sector and the

research base is still developing, but there's definitely enough evidence of efficacy to warrant further research in cereals and oilseed rape crops. What's needed is field-scale research to verify whether the results of glasshouse experiments are repeatable in a field situation," she says.

Seaweed extract is probably the biostimulant most familiar to growers, as it's been available for many years. The problem with seaweed extracts is that they are inherently variable as they are derived from different species and by different extraction processes, so will have different extract stability properties.

The majority of research on seaweed extracts has been on plants other than cereals and OSR. Looking at the data available, the ADAS review identifies significant increases in above-ground biomass, below-ground biomass and yield, with significant yield responses of up to 34%, reports Kate Storer.

Sajjad Awan believes that emerging biostimulant technology could have potentially huge uses for levy payers

Research round-up

AHDB Project 214-32125, A review of the function, efficacy and value of biostimulants available for UK cereals and oilseeds, ran from Nov 2015 to Jul 2016. Its aim was to introduce and define the term 'biostimulant', summarise availability, regulation and use, group the products in terms of mode of action, and assess scientific understanding. The project was led by ADAS and cost £27,014, funded by AHDB Cereals & Oilseeds.

but more research and funding is needed across the industry.

"Some of the microbial biostimulants help release phosphate in the soil which is often locked up so plants can't use it. The implication of this would be less reliance on imported inorganic phosphate fertilisers from turbulent parts of the world. Another step towards sustainable intensification," he notes. ■

An era of marginal gains

The thinking agronomist is probably one of the biggest sceptics when it comes to products that don't have independent science behind them, believes Dr Paul Fogg, cereal crop production specialist at Frontier.

"We're entering an era of marginal gains and as a result, interest in nutritional and biostimulant products is increasing as a possible means of making them. The problem is that in order to recommend a product confidently, it has to have a technological benefit and we need to understand how it works. Everything that goes into the tank needs to be justifiable at the end of the day," he says.

"The ADAS review is at last a piece of work that'll start to put the flesh on the bones by grouping biostimulants and review possible modes of action, an area where there is a general lack of understanding."

The current market place for these products is chaotic, with a range of different product types all bundled under the term 'biostimulant', he believes. To make matters even more confusing, the terminology isn't standardised, with some products also known as biologicals lumped in under the general biostimulant label.

"Biostimulant products can have a range of uses; some support crop growth, some help plants withstand stress and increase resilience in these situations, further products help plants access nutrients better and others are more

often considered as nutritional-type products (eg seaweed extract)," he says.

As far as using biostimulant products goes, Paul Fogg reckons that our basic understanding is better for some products than others. Phosphites are one example of a biostimulant product that is now being widely used and agronomists know how to use them.

But there are a wide range of other types of biostimulants that could potentially complement traditional chemistry although we're not so sure how to exploit them. According to Paul Fogg, there's a growing awareness of the importance of crop health and an interest in producing crops with less reliance on traditional chemistry.

"Elicitors look interesting because they can stimulate the plant's natural defences to combat disease. That could help take the pressure off fungicides which are increasingly at risk from developing resistance. The R&D pipeline has also slowed down, so fewer new active ingredients are coming onto the market," he comments.

"Other biostimulants could have a role in increasing efficient use of inputs. For example, pyroglutamic acid (PGA) plays a central role in nitrogen metabolism as a protein-forming amino acid. Supplementing levels of PGA can help plants utilise N more efficiently and cope better with stress.

"Some products trigger biochemical processes in plants, such as auxins and



For Paul Fogg to recommend a product confidently, it has to have a technological benefit and he needs to understand how it works.

cytokinins, which could be used to get the same effect as PGRs but at the moment we're just not sure where to use them strategically in crops," he says.

"No two products appear to be the same and work needs to be done to understand what each one brings to the table and how they interact with one another. We need to understand inter-season and inter-crop effects and above all, biostimulant products should pay for themselves. They have the potential to increase our ability to extract the genetic potential from crops but their adoption must be evidence led," he concludes.