

Biostimulants 101: What Are They and How Do They Work?

Sandy Shaw & Simon Neil, Berry Industry Development Officers

- This article provides an introduction to biostimulants
- Biostimulants are defined by what they do, not what they are or contain
- The action mechanisms are complex and still being researched, so it is advised to trial for yourself on your farm before you trust efficacy claims

What is a biostimulant?

Biostimulants are defined as a category based on their function, not their composition. There's a huge diversity in what they do and how they act on plants. There is currently no legislative framework in Australia that defines biostimulants, but Fertilizers Australia's voluntary Biostimulant Code of Practice defines biostimulants in the following way:

“A plant biostimulant is a substance(s), microorganism(s), or mixtures thereof, that, when applied to seeds, fertiliser, plants, the rhizosphere, soil or other growth media, act to support a plant's natural nutrition processes independently of the biostimulant's nutrient content. Plant biostimulants improve one or more of the following:

- *nutrient availability, uptake, or use efficiency,*
- *tolerance to abiotic stress such as drought, salinity, or disease.*
- *consequent growth, development, plant vigour, crop quality or yield.”*

You can read Fertilizer Australia's full voluntary **Biostimulant Code of Practice** at bit.ly/Bio-Cop

In this definition, the biostimulant category is classified predominantly by its effect on the plant, rather than its composition. It's a noisy category, with many claims about performance and benefits. There is a wide variety of products in the category, with a range of material sources and complexities, and spanning a range of modes of action, with more are being added all the time.

What are the categories of biostimulants?

Microbial based biostimulants

Microbial strains, such as *Bacillus* and *Trichoderma*, which are usually sold as soil amendments claiming to alter the soil microbiomes or as foliar fungicide prevention. This is a rapidly expanding segment of the biostimulant market.

Algae or plant extracts

Probably the original biostimulant, seaweed extracts from various algae species have been marketed as solutions to almost every problem in agriculture. Seaweed extracts often have a diverse and complex molecular makeup, and it can be difficult to determine what the key active molecule is.

Complex carbon-based biostimulants

Humic and fulvic acids are the best-known members of this category, which also includes biochars, composted waste, and liquid extracts of the previously listed. Added to the soil as plant stimulants, bioavailability facilitators, and nutrient solvents.

Protein Hydrolysates

Peptides and amino acids that are manufactured from protein sources, both animal and plant-based (for example, fish extract).

Plant Biostimulants and Their Influence on Nutrient Use Efficiency (NUE)

BIOSTIMULANT ABBREVIATIONS:

- Azospirillum (AZO)
- Humic Substances (HS)
- Azotobacter (AZT)
- Arbuscular Mycorrhizal Fungi (AMF)
- Protein Hydrolysates (PH)
- Seaweed Extracts (SWE)

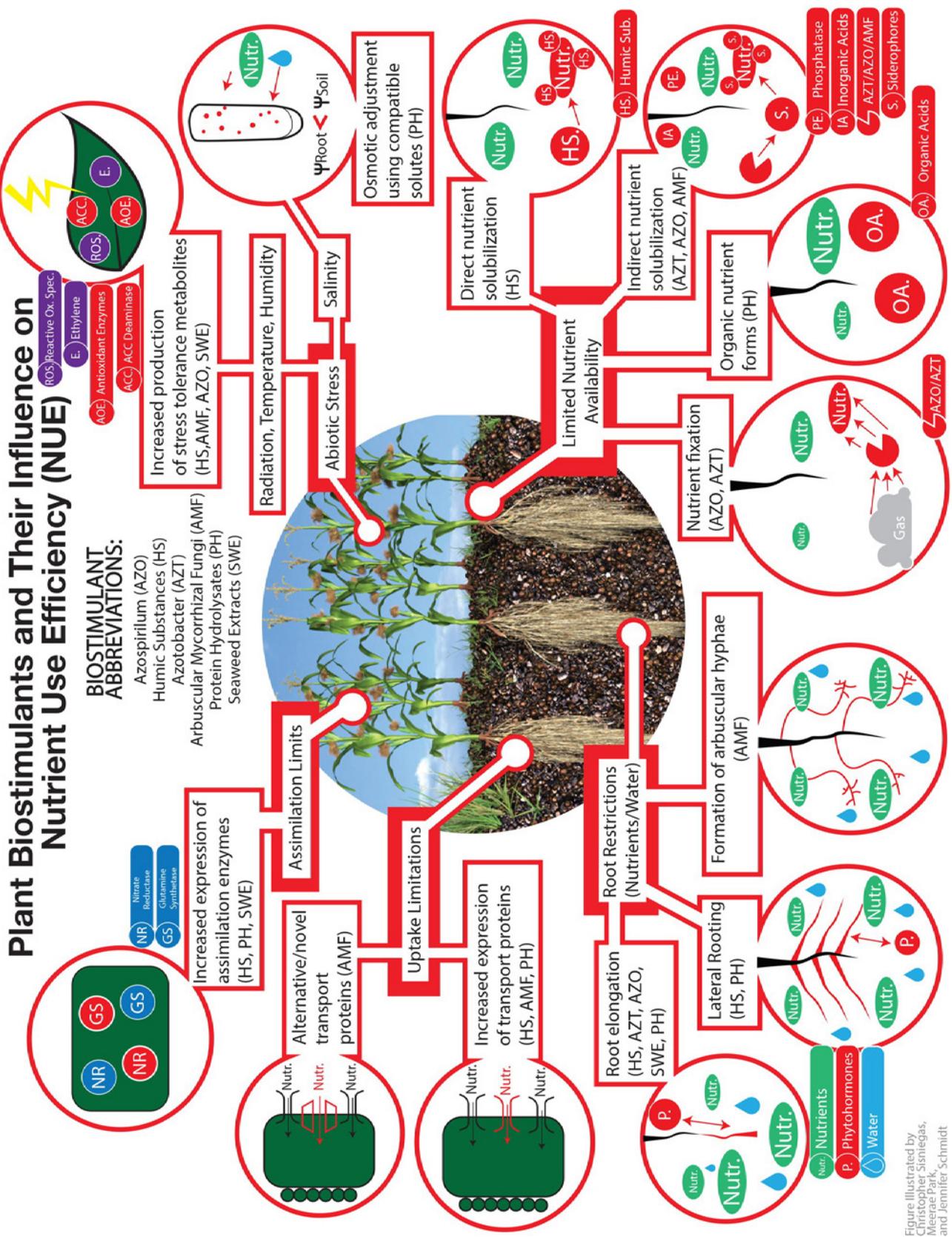


Figure illustrated by Christopher Sisinias, Meerae Park and Jennifer Schmidt

Figure 1. Representation of the various mechanisms by which the major classes of biostimulants are known to influence nutrient use efficiency in plants Figure illustrated by Christopher Sisinias, Meerae Park and Jennifer Schmidt for 'Biostimulants for Sustainable Crop Production' and reprinted here with the permission of one of the authors

Defined molecules purified from minerals, plants, animals, microbes, or obtained by synthesis

A large category encompassing non-humic organic molecules, such as chitin, chitosan, and polyphenols, and non-nutrient minerals, such as silicon.

These categories are defined more fully in Fertilizer Australia's voluntary Code of Practice

How do they work?

Although it has exploded as an area of focus for research, we have just scratched the surface of understanding how biostimulants work.

The field suffers from a lack of understanding of underlying principles, and a lack of robust, independent field trials. Research on how biostimulants work and if they even work in different crops and conditions is ongoing.

Based on current knowledge, biostimulants can have the following effects:

- stimulate stress tolerance or protective mechanisms (defences) in the plant, increasing the plant's tolerance of abiotic stressors
- increase nutrient availability by either directly or indirectly breaking down nutrients, stimulating soil production of those nutrients, or fixing them into the soil from the atmosphere
- stimulate root growth and therefore improve uptake
- increase plant uptake by increasing either transport proteins or assimilation enzymes within the plant (like putting more trucks on the road and building more depots to receive them)

Under the right conditions, biostimulants may protect plants from additional stress, potentially resulting in healthier crops, increased yield, improved quality metrics like firmness, shelf life, uniformity and premium packout.

References

Brown, P. (2025). Biostimulants: Their Function and Effective Use in Modern Agriculture.

Fertilizer Australia (2025). Biostimulant Labelling Code of Practice. [online] Available at: <https://fertilizer.org.au/biostimulant/biostimulant-cop>.

Rouphael, Y., du Jardin, P., Brown, P., De Pascale, S. and Colla, G. eds., (2020). Biostimulants for sustainable crop production. Cambridge, UK: Burleigh Dodds Science Publishing.

How to trial a biostimulant (without kidding yourself)

If you want to test whether a particular biostimulant is worth a few thousand dollars a season, why not run a simple on-farm trial that can actually show a difference?

1. Pick one target:

Choose a stress risk window you can reasonably predict (like heat at flowering, or EC creep during fruit fill)

2. Set up a basic comparison:

Treat one block and leave a comparable block untreated. If you can, repeat the comparison across a few rows to reduce any 'good patch vs bad patch' effects

3. Hold everything else steady:

Keep the same irrigation, fertigation, canopy management, and picking standards across your treated and untreated rows

4. Record one metric that pays:

Pick a commercial outcome you care about: percentage of first-grade pack out, rejects by reason (softness, size, blemish), or a simple shelf-life check, and record data against this outcome

For more in-depth advice on designing your own on-farm trials, visit the industry Resource Library at bit.ly/BA-RL and search 'DIY Research on-farm' to see the article from the Australian Berry Journal, Spring 2021 edition

Acknowledgements

This article is based on a lecture delivered by Dr Patrick Brown of the University of California, Davis, who graciously allowed the adaptation of his presentation to this journal format. We thank Dr Brown for his generosity in allowing us to adapt his presentation and for reviewing this article for accuracy.