Biostimulants: Getting the Best Out of the Wild West

Sandy Shaw & Simon Neil, Berry Industry Development Officers

- Australia does not regulate the efficacy or claimed efficacy of 'biostimulant' products for sale in Australia so it's important to understand that biostimulants are a complement, not a cure-all
- This article provides a practical approach to using biostimulants
- Be specific, sceptical and evidence-driven and focus on commercial return, not plant appearance

Australia does not regulate biostimulants, and there is no requirement for biostimulant products to prove their efficacy the way that regulated products like pesticides or fertilisers do. So, what questions should growers ask and what things should they keep in mind to keep their expectations realistic when working with biostimulants?

Why use biostimulants at all?

The only thing we can expect from the future is the unexpected, with increasing unpredictability in weather patterns and variable conditions. There has been an increase not only in the frequency and severity of extreme weather events, but also in the resulting abiotic crop stress, which can decrease crop quality and yield. Thoughtful use of biostimulants can help mitigate abiotic stress, serving as an additional tool alongside irrigation, crop protection, soil management, and other important tactics for preventing crop stress.

Nail the Basics First

Don't let biostimulants distract from fundamentals: irrigation reliability, drainage, sensible EC management, balanced nutrition, robust IPDM, and soil or media management will still be the main factors that influence your yield. If a biostimulant product works, it usually helps a good system maintain performance when conditions are less than perfect.

If those systems are robust and you're still seeing a gap between your potential and actual yield, there's room to experiment with biostimulants.

Set up for success

The most effective use of a biostimulant is to apply it before an anticipated stress event to help mitigate crop impact. By alleviating stress during the event, this should mean the crop will continue on with its normal growth and development (and yield).

For example, in many substrate systems, there is very little buffering capacity. This makes the substrate more sensitive to rapid shifts in moisture and EC. These rapid shifts can be predicted and anticipated if you have proper sensor monitoring set up.

Biostimulants may or may not have an effect. You need to have the information available to you (weather, water, other stressors) to make an informed decision and determine whether you're willing to spend a few thousand dollars on the product. You need to be able to calculate whether the stress event will occur and whether you think it's worth the time, money, and effort to invest in biostimulants to try to mitigate the stress effect.

Ask yourself these three questions:

1. Which specific stress interaction issue is this solving?
2. When should I apply the product to ensure I precede the risk window where that stress will occur?
3. If this treatment works, what effect will it have on yield or quality, and will it be a large enough effect to be worth the investment?

Get Specific

Biostimulants are an incredibly diverse range of products. You have to get specific about what you want the product to achieve, how you want it to do that, and when you want it to happen. What problem exactly do you want to solve? Know that before you buy and apply.

Really, really specific

Biostimulants are not a one-size-fits-all solution, and their effectiveness is site-specific to the plant, the environment, and the target action. Biostimulants are less predictable because they're more dependent on interactions, so really drill down with your salesperson about how the product works and whether it has been tested in your conditions and on your crop. Work with a company that understands your specific site history and is aware of your specific challenges.

Ask the biostimulant salesperson to tell you exactly what problem their product solves. They should know the nuances of your crop enough to be able to tell you specifically within your crop, your needs, and your challenges, what problem their product will solve. If they can't do that, then walk away.

Some biostimulants provide very general benefits which may work similarly across different crops. Be mindful of if success in your crop looks like success in the tested crops. A product which stimulates vegetative growth could be wonderful for wheat at germination, but unsuitable and - in fact downright undesirable - for berries mid-production.

Be skeptical of cure-alls

No product will solve all problems. If a product claims to solve cold, heat, ripening, damp, etc., etc. walk away. Those are all different biological processes, and there's no way one single product can address every one. In the context of fertilisation programs, a biostimulant is a complement to a good fertilisation program, not a replacement. They improve nutrient uptake, but you still have to put the nutrients there to be absorbed.

Temper your expectations

Biostimulants act best in facilitating protective responses to modest stress. A biostimulant won't save your plants during prolonged weather events like the millennium drought, but they have the potential to alleviate the effects of moderate stress, like short periods of excess temperatures or small periods of water deficit.

Are the promises logical?

Take a moment to consider whether the product's promises meet logical expectations. For example, a hectare of soil (30cm deep) at 2% organic matter contains around 80–90 tonnes of organic matter. Adding 10–50 kg of a humic product cannot "rebuild" that soil structure. Is that 10-50 kg realistically going to significantly alter the environment of your soil, or is it a teaspoon in an ocean? Scientists now think that humic acid works by forming a mild irritant to the surface of the plant, triggering that plant's stress response system. This makes more logical sense than a small input into the soil fundamentally changing the structure.

Lab experiments don't always reflect field reality

Cropping systems are complex systems and not always replicable on an agar plate. A single microbe growing on an agar plate is not representative of a soil environment, where it competes and interacts with hundreds of other microbes. The interactivity of different stress factors also isn't replicated.

Because of the costs and complexity of rigorous field trials, the majority of the studies and promotional materials you'll see are likely to be lab-based. The results may look impressive in the lab but cannot be guaranteed until efficacy is demonstrated in the field.

Always ask for the conditions under which the data was collected: was it lab or field-based? In a petri dish? Potted plant? Trial field? Did the environmental conditions reflect yours? These specifics will help you determine how much you trust the data to be applicable to your particular needs.

Be aware of publishing bias

Meta-studies are the gold standard of scientific rigour. They collect the results from multiple trials and analyse the results as a block. However, what gets analysed in a meta-study must first be published in a scientific journal.

Scientific publications show a strong bias toward publishing only positive results. A 2024 meta-study of ~180 field trials comparing ~1000 biostimulants found a generalised increase in yield response across biostimulant types. But it's almost impossible to publish papers with null or negative results, so there's a bias inherent in the published literature. Similarly, in a commercial sense, companies may have done a trial 25 times and are showing you the one time it worked.

The general indication across the studies is that some products do work but always be cautious. Always ask: how many trials have you done on this product? How many times have you gotten this result?

Do your best to verify product efficacy

Since biostimulants are unregulated and don't need to provide proof of efficacy, there's plenty of product variation out there. Formulations change sporadically, products don't always contain the components they claim, and some of these products will never work, no matter how well you time it. The reality is that this is still an emerging industry, and probably only about 10% of the biostimulant products out there are effective.

The ones that work and are applied effectively can be extremely successful, but it is advised to be cautious and sceptical unless you're presented with compelling evidence. Work with companies that are looking in-depth at the biology and targeting specific stress points in the cropping cycle, and who are more than happy to show you the data.

If you do end up investing in a biostimulant that doesn't work out, then the good news is that the only likely downside is that you've wasted some money. Most biostimulant trials show that applications that don't work have no effect on the crop, and very few have any negative effects.

Real world example: Phosphorus Solubilisation

Phosphorus is not as easily soluble as other key elements, and products which help convert more phosphorus in the soil into a soluble form for crop uptake is a source of interest to many growers. In 2021, researchers performed a metastudy (a collection and review of all papers and data on a certain subject) which looked at the results of 724 studies looking at products which promoted phosphorus availability by converting it to a soluble form. 629 of those studies were lab based, which on average showed 75% improvements in phosphorus availability. 95 of those studies were field based. As soon as the experiments became field based, the improvements dropped like a stone – showing averages of 20% improvements in phosphorus availability.

Of the 724 studies, only 95 were field based and of those only 14 used yield as a measure of effectiveness. Only 5 of the 724 studies showed any positive effect as measured by an increase in crop yield. This doesn't mean the other studies are bad, or not scientifically rigorous – it just means they're not necessarily directly applicable to a grower. If you were presented with those odds, would you invest in the product?

Keep in mind your bottom line

While healthier plants are a positive sign, they don't always pay the bills. For example, while extensive root systems are vital for absorbing water and minerals, growing excessive rooting structures in nutrient-rich, fertigated substrate systems can be an energy cost that doesn't always translate to extra fruit yield.

Ultimately, yield and quality improvements are what growers want out of their product. Focus on the commercial outcomes.

Summary of questions to ask yourself:

- Are all my basics up to scratch?
- What problem do I want to solve?
- What stress interaction does that problem create?
- How do I specifically target that stress interaction?
- When is that stress interaction likely to occur?
- When should I apply the product to ensure I precede the risk window where that stress will occur?
- Does the data available to me suit my crop and conditions?
- Do I know how this data was generated?
- If this treatment works, what effect will it have on yield or quality and will it be a large enough effect to be worth the money?

References

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

Colla, G., Hoagland, L., Ruzzi, M., Cardarelli, M., Bonini, P., Canaguier, R. and Rouphael, Y. (2017). Biostimulant Action of Protein Hydrolysates: Unraveling Their Effects on Plant Physiology and Microbiome. Frontiers in Plant Science, 8. doi:https://doi.org/10.3389/fpls.2017.02202.

Li, Jing, et al. "A Meta-Analysis of Biostimulant Yield Effectiveness in Field Trials." Frontiers in Plant Science, vol. 13, 2022, article 836702, https://doi.org/10.3389/fpls.2022.836702

Li, J.-T., Lu, J.-L., Wang, H.-Y., Fang, Z., Wang, X.-J., Feng, S.-W., Wang, Z., Yuan, T., Zhang, S.-C., Ou, S.-N., Yang, X.-D., Wu, Z.-H., Du, X.-D., Tang, L.-Y., Liao, B., Shu, W.-S., Jia, P. and Liang, J.-L. (2021). A comprehensive synthesis unveils the mysteries of phosphate-solubilizing microbes. Biological Reviews, 96(6), pp.2771–2793. doi: https://doi.org/10.1111/brv.12779.

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.

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.