e-GRO Alert

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Biostimulants for Greenhouse Ornamental Crop Production

This article provides an overview of what biostimulants are, how they can improve the quality of greenhouse ornamental crops, and key considerations for choosing and using biostimulant products effectively.

What are biostimulants?

You can't go to a trade show or peruse a greenhouse magazine without seeing advertisements for biostimulants. These products claim enhanced water uptake and nutrient utilization, increased tolerance to environmental stresses (i.e. abiotic), and improved growth, plant quality, flowering, and yield. They may also be called plant conditioners, bioactivators, or bioenhancers.

Figure 1. Biostimulant research conducted at The Ohio State University. Photo by: Michelle L. Jones.

The 2018 Farm Bill defines a plant biostimulant as "a substance or micro-organism that, when applied to seeds, plants or the rhizosphere, stimulates natural processes to enhance or benefit nutrient uptake, nutrient use efficiency, tolerance to abiotic stress, or crop quality and yield." But what does that really mean?

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The definition of a biostimulant, and what ingredients contribute to positive plant growth and stress responses (Fig. 1), may be somewhat ambiguous. Biostimulants may contain humic substances (e.g. humic acid and fulvic acid), protein hydrolysates, biopolymers, botanical extracts, and/or beneficial microorganisms (Table 1). Some biostimulant products contain a single active ingredient, but many contain combinations of various categories of active ingredients or large consortia of beneficial bacteria and fungi.

Biostimulants are not pesticides or fertilizers. While biostimulants may improve plant health, and healthier plants are more resistant to insect and pathogen damage, biostimulants cannot make direct disease or pest control claims. Biostimulants should stimulate natural processes in plants that lead to improved growth and stress tolerance, this means that growth promotion from biostimulants should not merely be the result of supplied macro and micronutrients. Biostimulants alone should not provide any nutritionally relevant fertilizer benefit.

How can biostimulants improve ornamental crop quality?

Plant biostimulant products provide natural and sustainable tools that can be used in conjunction with synthetic chemical inputs for overall plant health management. These products can improve crop quality at all stages of the production and marketing chain from young plant production to shipping and retailing. Biostimulants can increase the quality of

Humic Substances
Humic acid
Fulvic acid
Protein Hydrolysates
Animal amino acids
Plant-derived amino acids
Biopolymers
Chitosan *(commonly derived from crustacean shells)*
Laminarin *(storage glucan of brown algae)*
Botanical Extracts
Algae
Brown seaweed
Diverse plant extracts
Beneficial Microorganisms
Bacteria • *Bacillus* • *Pseudomonas* • *Rhizobium*
Fungi • Endomycorrhizae • Ectomycorrhizae • *Trichoderma*

Table 1. Biostimulants may contain nonmicrobial (humic substances, protein hydrolysates, biopolymers, or botanical extracts) or microbial (beneficial bacteria or fungi) active ingredients. Table by: Michelle L. Jones.

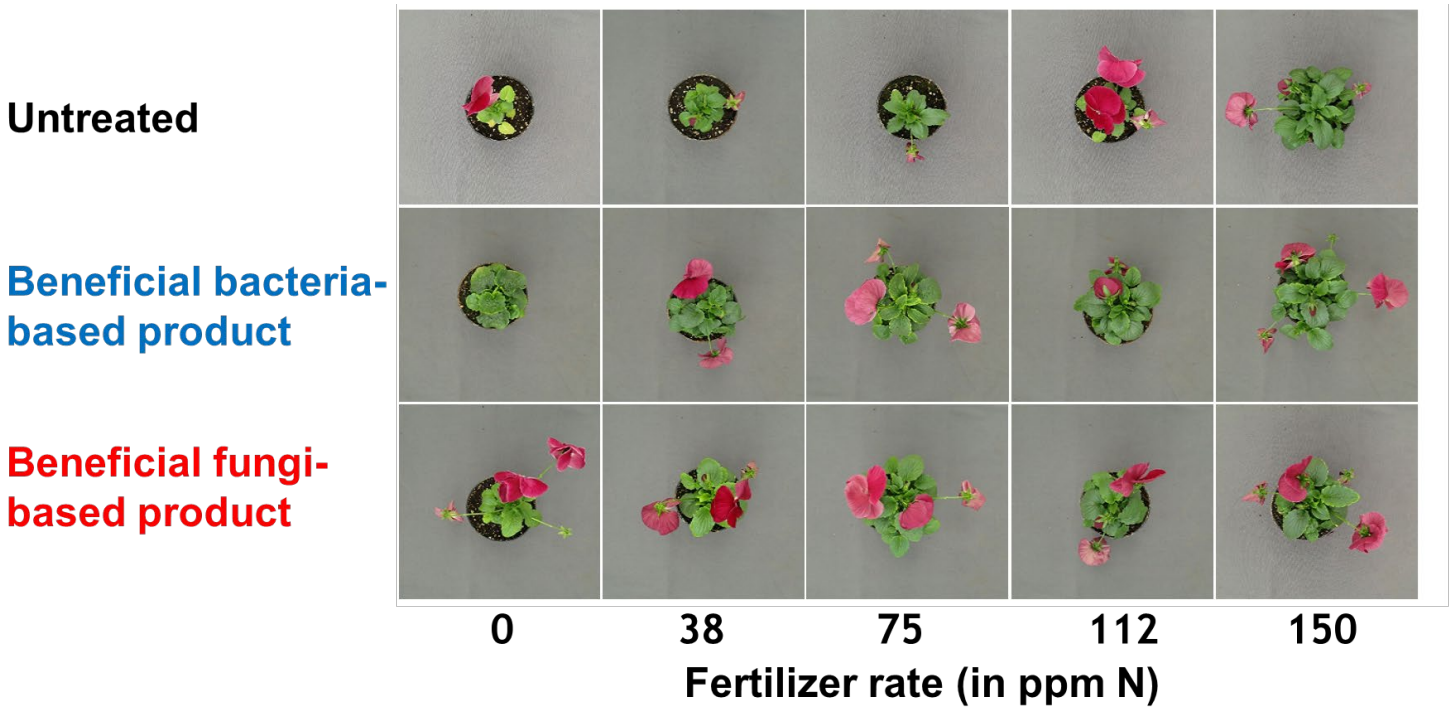
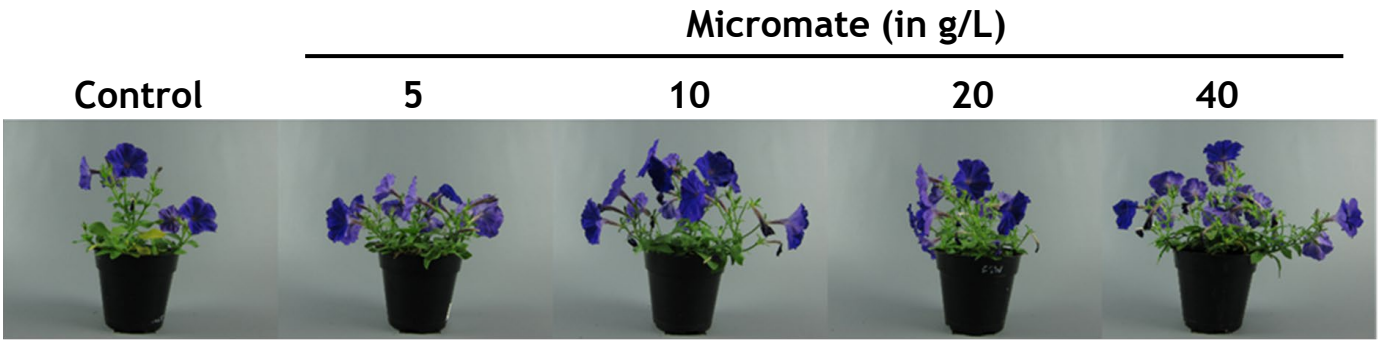


Figure 2. Pansies were grown with different rates of nitrogen from a 15-5-15 fertilizer to illustrate the effects of fertilizers on biostimulant efficacy. The top row of plants was not treated with a biostimulant (control). The middle row of plants was treated with a product (Cease) containing the beneficial bacteria, *Bacillus subtillis* strain QST713. Cease was applied as a weekly substrate drench at a rate of 6 quarts per 100 gallons. Please note this product (Cease) was used because the bacteria has biostimulant properties, but the Cease is labeled as a biofungicide. The bottom row of plants was treated with a beneficial fungi-based product (MycoApply Endo). MycoApply Endo contains four species of endomycorrhizal fungi and was incorporated into the substrate at a rate of 0.96 pounds per cubic yard. The greatest effects of growth promotion from the beneficial microorganisms can be seen at lower rates of fertilizer like 75 ppm N. Figure by Laura Chapin.



# flowers (compared to control)	+6.5	+7.7	+5.3	+9.4
Days to first flower (compared to control)	-3.2	-3.2	-6.6	-6.9

Figure 3. A biostimulant containing humic and fulvic acids (Micromate) increased vegetative growth and flowering in petunia grown at lower fertilizer rates (50 ppm N from 20-3-19). Petunias had 5–9 more flowers per plant and flowered 3-7 days earlier. The substrate was drenched with Micromate weekly. Figure by: Evili Martins.

ornamental crops through different mechanisms, resulting in a variety of benefits, such as: improved seedling vigor, greater shoot or root growth, greener leaves (i.e. increased chlorophyll content), increased flower numbers, larger flowers, and/or decreased time to flowering (i.e. decreased production timing). While many products claim that they increase plant growth, an increase in vegetative growth can be at the expense of flowering, which is not a desirable outcome in flowering ornamentals. Therefore, it's important to choose a biostimulant product that will stimulate plant growth appropriate for your specific crop and marketing criteria.

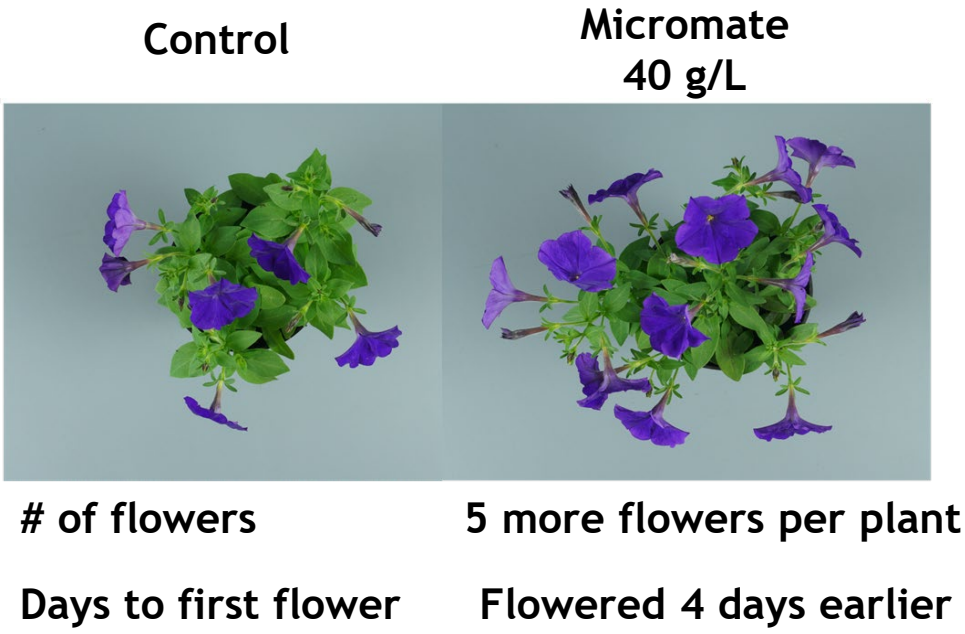


Figure 3. Growth promotion was also seen at higher fertilizer rates (150 ppm N from 20-3-19) when petunias were treated with a biostimulant containing humic and fulvic acids (Micromate). Figure by: Evili Martins.

Getting consistent responses from biostimulants can be challenging. There are many factors that can influence the efficacy of biostimulants including fertilizers, substrate composition (bark, peat, coir, etc.) and pH, application methods, and other chemical applications. Fertilizer is one of the most important production inputs influencing the efficacy of biostimulants, especially those that contain beneficial bacteria or fungi. Many beneficial microorganisms promote plant growth by solubilizing macronutrients like phosphorus and potassium and making them more available for plant uptake. If the plants are already receiving all the nutrients they need from high fertilizer applications, then you may not see the benefits of biostimulants. High rates of phosphorus can also directly suppress colonization by mycorrhizal fungi and reduce the activity of phosphate solubilizing bacteria. Figure 2 shows an experiment with pansy, where the application of two microbial products clearly enhances growth when fertilizer rates are lower (rate of 75 ppm N), but this growth promotion is not seen when rates are higher (rate of 150 ppm N). This experiment also illustrates one of the greatest potential benefits of biostimulants, which is to use them to grow high quality ornamental crops with lower fertilizer inputs.

Humic substances are decomposition products of organic matter, and fulvic and humic acids are common components of biostimulants. These substances can increase water holding capacity of soilless substrates, increase nutrient uptake, and stimulate native microbial activity. Similar to our experiences with microbial-based biostimulants, we have had successes and failures with using humic substance-containing biostimulants to improve plant growth. In a recent trial with three commercial products, we found only one that consistently improved plant growth at multiple rates as a substrate drench (https://doi.org/10.21273/HORTSCI17554-23).

When petunias were grown with a lower fertilizer rate of 50 ppm N (continuous liquid feed from 20-3-19 Petunia FeED), weekly drenches with fulvic and humic acids from the biostimulant, Micromate, improved vegetative growth, increased flower numbers, and decreased the days to first flower (Fig. 3). When Micromate was drenched weekly at a

rate of 40 g/L the petunias flowered almost one week earlier, and plants at 4 weeks after transplant had an average of 9 more flowers per plant. In contrast to the fertilizer effects that we have observed with microbial biostimulants, we also observed growth promotion from the Micromate treatments at higher fertilizer rates. When petunias were grown with a higher fertilizer rate of 150 ppm N (from 20-3-19) a visual difference in plant growth and development was also observed, although the improvement was not as great as was observed for plants at the lower fertilizer rate. Petunias at higher fertility, drenched weekly with 40 g/L Micromate, had 5 more flowers per plant (compared to 9 at low fertility) and flowered 4 days earlier (Fig. 4).

How do I choose a plant biostimulant?

Choosing a biostimulant can be overwhelming. Whichever products you choose, test them in a small area before applying to your entire crop. This trialing will allow you to optimize application timing and rates and determine how your growing environment and other inputs will influence the growth responses that you observe in your crops. If your goal is to use biostimulants to reduce fertilizer applications, start your trial at 75% of your normal fertilizer rate.

Do your homework and ask lots of questions before you start your trials.

- Have these products been tested in independent, third-party trials, and can you see the results?
- Has the product been shown to work as promised on the plants you are growing?
- Has the product been tested in soilless growing substrates?
- Are there any potential phytotoxicities or incompatibilities with other products?
- Is the plant species compatible with the product? For example, some plants like carnations do not form mycorrhizal associations so products that contain mycorrhizal fungi will have no benefit for these crops.

All biostimulants, even those with the same active ingredients, are not equal and the product formulations are very important. Biostimulants have great potential to reduce various chemical inputs without sacrificing plant growth or crop quality. However, with the introduction of any new product, it is vital to consider both the risks and the rewards. When implemented properly, biostimulants can serve as a great addition to your grower's toolbox, resulting in higher quality plants, decreased costs, and reduced environmental impact.

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