GROWERTALKS

Features

1/30/2026

Biostimulants & How You Use Them

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American Society for Horticultural Science

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Biostimulants are a class of biological products (bioproducts) that can be used in greenhouse floriculture production to promote plant growth and enhance overall crop quality. These bioproducts most often include microbial components, such as beneficial bacteria (e.g. Bacillus or Rhizobium) or fungi (e.g. Mycorrhizal fungi or Trichoderma), but they may also contain non-microbial active ingredients, including humic or fulvic acid, algae extracts, chitosan or protein hydrolysates.

Some biostimulants may contain single strains of microbes or combinations of microbial and non-microbial ingredients. Other classes of microbial biproducts, including biopesticides, may contain strains of beneficial microbes that are similar to those found in biostimulants. For example, Bacillus subtilis strain QST 713 (the active ingredient in the biopesticide Cease) also has biostimulant properties, including growth promotion.

Microbial biostimulants can promote plant growth and improve crop quality by increasing the availability of macro and micronutrients and improving nutrient uptake by the plant. They can also enhance a plant tolerance to environmental stresses such as nutrient deficiencies and water deficit. In floriculture crops, plant growth-promoting bacteria have been shown to improve growth and increase tissue nutrient concentrations.

While these improvements in nutrient use efficiency suggest that microbial biostimulant applications may allow growers to produce high-quality crops with lower fertilizer inputs, inconsistent plant responses have slowed large-scale adoption of these practices by the floriculture industry. The efficacy of microbial biostimulants is highly influenced by fertilizer applications, substrate physical and chemical properties, application methods and plant species.

Two commonly studied beneficial microbes, mycorrhizal fungi and bacteria from the genus Bacillus, have shown promise in enhancing floriculture crop quality. We therefore designed an experiment to investigate whether biostimulants containing these microbes could support high-quality pansy production under reduced fertilizer inputs.

The full details of this study are published in the American Society for Horticultural Science's journal HortTechnology (Chapin and Jones 2025).

Methods

Starting at transplant, *Viola* × *wittrockiana* Delta Pure Rose (pansy) seedlings were treated with commercial microbial biostimulants. MycoApply Endo (Mycorrhizal Applications), with arbuscular mycorrhizal fungi (*Glomus intraradieces*, *G. mosseae*, *G. aggregatum* and *G. etunicatum*) as active ingredients, was incorporated into the peat substrate following product instructions (0.56 kg·m-3). Cease (BioWorks Inc.), with *Bacillus subtilis* strain QST 713 as the active ingredient, was applied as a weekly substrate drench of 100 mL per pot at the recommended rate (15 mL·L-1).

Figure 1. *Viola* × *wittrockiana* Delta Pure Rose (pansy) seedlings were grown in 11.4-cm diameter round pots filled with peat-based substrate (PRO-MIX BX) in The Ohio State University research greenhouses in Wooster, Ohio. Environmental conditions included daytime temperatures of 66 to 69F (19 to 21 C) and nighttime temperatures of 60 to 64F (16 to 18 C). A combination of supplemental lights and shadecloth was used to maintain a light intensity of 250 to 400 $\mu mol \cdot m^{-2} \cdot s^{-1}$ during a 14-hour photoperiod. Plants were arranged as a randomized complete block design with 18 replicates. Treatments included five different fertilizer rates 0, 0.25, 0.5, 0.75 or 1.0X (1.0X = 150 mg·L-1 N from 15N-2.2P-12.5K-2.9Ca-1.2Mg Jack's Professional LX fertilizer) indicated by different colored tags and three biostimulant treatments (MycoApply Endo, Cease and untreated). Figure (right images) created with assistance from Microsoft Copilot.

The control treatment included untreated plants with no biostimulant applications. Plants were fertilized twice weekly with 0X (no fertilizer), 0.25X, 0.5X, 0.75X or 1.0X water-soluble fertilizer, where 1.0X represents 150 mg·L-1 nitrogen (N) from 15N-2.2P-12.5K-2.9Ca-1.2Mg Jack's Professional LX fertilizer (J.R. Peters; see Figure 1).

Results

In this experiment, we showed that adding microbial biostimulants overcame the effects of low fertilizer rates. When plants were under extreme nutrient deficiency (0X rate, no fertilizer added beyond initial substrate charge), both biostimulants improved flower numbers and plant biomass compared to untreated pansies (Figure 2). At the 0.5X fertilizer rate (half-strength; 75 ppm N) biostimulant-treated plants were larger and had more flowers than the plants that weren't treated with biostimulants.

These differences can easily be distinguished visually in the photos in Figure 2. The biostimulant-treated plants were of sufficient size, leaf coloration and flowering to be considered marketable quality, while untreated plants fertilized with the same rate of fertilizer (0.5X) didn't have foliage coverage and quality, and they'd just started to flower.

At the 1.0X rate of 150 ppm fertilizer, the differences between the untreated (control) and biostimulant-treated plants was no longer visually evident (Figure 2). Our data also didn't show any differences in shoot dry weight or flower numbers between the biostimulant treated and untreated pansies at the 1.0X fertilizer rate.

This research shows that at high or optimal levels of fertility, when plants have all the nutrients that they need for growth, you may not get a growth-promoting benefit from microbial biostimulants. Also of note is the fact that pansies of similar size and quality to controls fertilized with the optimal rate (1.0X) could be produced with half the fertilizer (0.5X rate) when plants were treated with either Cease (*Bacillus subtilis* QST 713) or MycoApply Endo (arbuscular mycorrhizal fungi). Pansy responded positively to both biostimulants, but the MycoApply Endo resulted in slightly higher flower numbers and increases in shoot biomass than the Cease treatment.

Take-home messages

All plant species may not respond equally to all microbial biostimulants, so it's important to test products on all the species you're growing before large-scale implementation. While mycorrhizal fungi form symbiotic relationships with approximately 95% of land plants, there are some important greenhouse crops, such as carnation and stock, that don't form these associations and wouldn't benefit from biostimulants that contain mycorrhizal fungi.

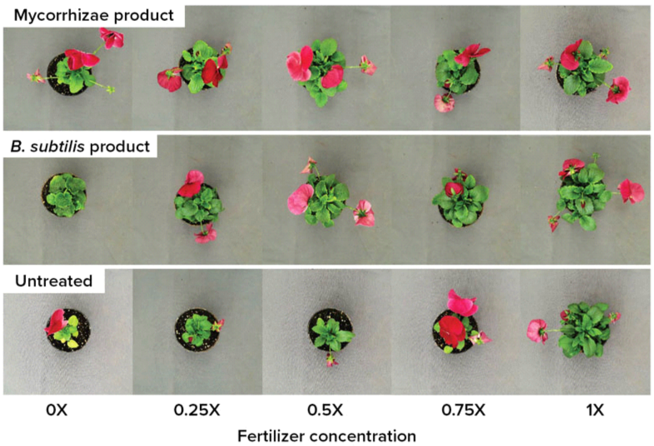

Figure 2. Representative pansy plants in response to microbial biostimulants and different fertilizer concentrations (n = 18 plant replicates). Plants were treated with either a mycorrhizae-based biostimulant (MycoApply Endo, Mycorrhizal Applications), a bacteria-based biostimulant (*Bacillus subtilis* QST 713; Cease, Bioworks Inc.) or untreated (control). Fertilizer was supplied at rates of 0, 0.25, 0.5, 0.75 or 1.0X (1.0X = 150 mg·L-1 N from 15N-2.2P-12.5K-2.9Ca-1.2Mg Jack's Professional LX fertilizer).
Photo courtesy of Michelle L. Jones and Laura J. Chapin.

Much less is known about the host specificity of the plant growth-promoting bacteria in many biostimulant formulations. Including microbial biostimulants in a greenhouse nutrition program can reduce fertilizer use by up to 50% without compromising plant quality, offering both economic and environmental benefits for growers. To ensure these benefits are realized under your specific production conditions and with different plant species and cultivars, you should conduct small-scale trials before fully adopting reduced fertilizer practices in combination with biostimulants. **GT**

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