Julie Weiland and Henry Thorpe evaluate trays of plants that have been treated with Messenger either 1) in the plug stage, 2) in the plug stage and again after transplant, 3) only after transplant, or 4) not at all.

Photos: Stanton Gill

Stronger Plants Through "Harpin" Technology

by **STANTON GILL AND DEBORAH SMITH-FIOLA**

Researchers look at how harpin proteins can stimulate a plants natural defense systems

You've heard of IPM (integrated pest management), right? And maybe you've heard of PHC (plant health care). Here's a new term for growers: PHR, or plant health regulators. What are plant health regulators and what can they do for you? This past summer, Eden Bioscience, a biotech company out of Bothell, Washington, asked us to help test a new product that's been classified as a PHR and which they're marketing under the trade name Messenger. Messenger's active ingredient is called a "harpin" protein.

Do you want a stimulated plant?

What's harpin? Well, the harpin protein is identical to a naturally occurring protein present in several plant pathogens, including *Erwinia amylovora* (fire blight). When harpin is sprayed onto the foliage and stems of a plant, plant

The researchers tested the effects of Messenger on ageratum, celosia, petunia and vinca. Most of the tests showed favorable results.

Vinca treated with Messenger were were "clearly superior" to untreated controls, which suffered disease and root rot.

receptors recognize the protein's presence and send a signal throughout the plant that activates the plant's natural ability to protect itself—its defense system. Hence, you've got a stimulated plant that has more vigor and stamina.

The harpin protein activates several internal biochemical responses within the plant. In the case of fire blight, the plant prevents the spread of the pathogen at the site of infection by creating a physical barrier.

Research has shown that harpin has multiple effects and different types of plants respond differently. In some cases, it enhances plant growth, in other cases it purportedly increases insect and disease resistance. According to Eden Bioscience, it "stimulates the salicylic acid–dependent pathway, the jasmonic acid–induced pathway (involved in plant defense) and plant growth systems, including enhanced nutrient uptake and increased net photosynthesis." In other words, harpin may induce increased photosynthesis and nutrient uptake, potentially resulting in benefits such as increased biomass, improved root development, earlier flowering and, with fruit and vegetable crops, improved yield and size.

The harpin protein is labeled for both commercial and home garden use, in indoor and outdoor plants, including trees and shrubs. It's currently being used on everything from cherries and potatoes to tobacco and roses. Harpin is also virtually non-toxic to humans and the environment. As a result, the EPA has labeled Messenger as a toxicity category IV product, a designation reserved for materials with the lowest hazard potential. It has a 4-hour REI. It's non-phytotoxic to all species tested so far.

Can harpin help floriculture?

The University of Maryland Cooperative Extension has made a first attempt at quantifying whether harpin proteins have a positive impact on flowering horticultural plants. In the spring of 2003, we recruited Catoctin Mountain Growers, Detour, Maryland, a large commercial greenhouse operation owned by Bob Van Wingerden. Bob agreed to work with us on a field trial and turned us over to his forward-thinking head grower Henry Thorpe and associate grower Julie Weiland.

We asked Henry and Julie to help us choose four annual bedding plant species/cultivars that had regular problems with insects or disease and two that were drought sensitive or drought tolerant. The growers, the researchers and Eden Bioscience technical representative Paul Bystrak selected vinca Coconut Cooler (heat and drought tolerant), ageratum Hawaii Blue (shade tolerant, drought sensitive), celosia New Look (plumose type, drought tolerant) and petunia Ultra Pink (drought sensitive, shade tolerant).

The vinca and celosia were sown on May 4 and the ageratum and petunia on May 8 (each in 200-cell plug trays). Plugs were transplanted to 6-in. pots on May 14 with four plants per pot and six pots per flat.

We mixed a 7.5-g packet of Messenger in 1.5 gal. of distilled water and applied it at midday using a hand-pump sprayer. Silwet was added at the label rate (2 ml/L). The spray volume treated approximately 1,300 sq. ft.

Our test groups included a control group (no applications), a "before" group (Messenger applied to plugs), a "before and after" group (Messenger applied to plugs and then two weeks after transplanting into 4.5-in. pots), and an "after" group (Messenger applied two weeks after transplant).

Each treatment was replicated six times (six flats per treatment, or 36 pots) for each of the four plant varieties. Plants were placed in blocks in the greenhouse following treatment and treated identically. The weather during this experiment was extremely atypical for late spring: continued cool, overcast, with on-and-off rain. These cool conditions created a setback in the production schedule, delaying vinca growth and flowering in particular.

Results: flowering

AGERATUM. By June 4, all treatments showed color, with no visual differences between treatments noted. Messenger-treated plants were considered ready for market by June 11. There was a trend showing more flowers on "before" and "after" treatments. On June 18, the "before and after" and "after" treatments exhibited more blooms. In fact, the "before and after" treatment did have significantly more flowers than the other treatments.

CELOSIA. Bloom initiation was most prominent on the "before" treatments on May 28, with about 85% of the plants showing red plume initiation.

PETUNIA. The mean number of fully open blooms per pot for the last week of May was much greater for plants receiving the "before and after" treatment (average of 11 blooms) compared to the "before" treatment (6.5 blooms), the "after" treatment (5 blooms), and the control (4.5 blooms). By June 4, all plants were considered to be ready for market. At this point, Henry commented that he saw few visible differences between plants. Indeed, all treatments averaged around five blooms per pot compared to the control, which had an average of two blooms per pot on this date.

On June 11, Henry again observed no visual difference in flowering between all treatments. The statistical analysis showed that the control treatment had fewer flowers than the other treatments, although this wasn't significantly different than the "before and after" treatment. This wasn't apparent visually but shows a distinct increase in early-flower response. The "before" treatment showed the most precocious flowering, but posttrial data shows that the "after" treatment also had increased flower numbers.

VINCA. Vinca was slow to bloom due to the extended cool weather during this trial. Bud counts weren't significantly different between treatments. The "before" treatment seemed to show the best flowering response, although variability among plants didn't allow statistical significance.

Results: growth

AGERATUM. There was no significant difference in growth between Messenger treatments. This was measured by foliage height, width of pot and volume of the flat. However, there seemed to be a trend in growth, with the "before and after" treatment having the strongest effect.

CELOSIA. Two weeks into the trial, Henry commented that the "before" treatment "looked better" (more vigorous, slightly bushier). The data shows a trend that the Messenger treatments increased the flat volume compared to the control. By June 4, treated plants had visibly thicker stems than the control plants. By the end of the trial, the "before" plants were statistically larger than both the control and "before and after" plants, although there was no difference compared to the "after" plants.

PETUNIA. Treatments applied to petunia seemed to decrease the overall growth rate. However, since no growth regulator was applied to these plants during this trial, the plants were overgrown and leggy. Therefore, the decreased growth potentially resulted in a more aesthetically pleasing compact plant. There were no significant differences between treatments.

VINCA. Vinca growth was lackluster during this trial due to cool weather conditions. There were no significant differences in early growth between treatments. By June 4, however, Henry commented that the "before" as well as the "before and after" treatments looked better. By the end of the trial, the "before" plants were clearly superior to untreated controls. The "after" treatment was also larger than the control, but not significantly.

On a side note, Henry experienced very high vinca loss in his other greenhouses due to disease and root rot. Neither of these conditions existed on plants in our trial.

Results: drought tolerance

Plants removed from their growing areas and allowed to dry down took over a week to dry down to the point that wilt was evident. The vinca in particular took almost two weeks to reach the wilt point, due, undoubtedly, to the prolonged cool, overcast weather in the 60s (F). Petunia was the first to wilt, fol-

ROOT SYSTEM RESULTS

PLANT	"BEFORE"	"BEFORE AND AFTER"	"AFTER"	CONTROL
Ageratum	5 (B)	5 (A)	5	5
Celosia	5	5	5	4 (D)
Petunia	5	5	5	5
Vinca	4	5 (A)	4	3 (D)

Deborah Smith-Fiola applies harpin protein (Messenger) to a test block of plants. In the trial, all treated plants showed better growth than those that received no treatment.

lowed by ageratum, then celosia. No observable differences were noted between treatments once plants were rehydrated. The ageratum had some browning on the edges of foliage only. The plants used in this study were put back into their blocks following this experiment, where they simply appeared a bit smaller than their fellow plants were.

Results: root system

Three evaluators ranked the root systems on a scale of 1 to 5. (1 = 0 to 20% of the visible surface is roots; 2 = 21 to 40% of the visible surface is roots; 3 = 41 to 60% of the visible surface is roots; 4 = 61 to 80% of the visible surface is roots; 5 = 81 to 100% of the visible surface is roots.) Roots received the highest rankings if they filled the overturned pot surface. A = distinct best appearance of group; B = second-best appearance; D = worst appearance of group.

Results: visual appraisal

Four evaluators ranked random test plants in a blind test according to overall appearance, overall vigor and marketability.

AGERATUM. All evaluators considered the plants with the best overall appearance to be those in the "after" treatment. The two growers considered the "before and after" plants the most vigorous, compared to the two consumers, who considered the "after" plants to be most vigorous. Both growers thought the most marketable plants were those in the "after" treatment, which barely beat out their second favorite, and the favorite of the consumers, the "before" group.

CELOSIA. The two growers considered the "after" plants to be the nicest overall, while the consumers preferred the "before" plants. The ranking of vigor was mixed between the "before" plants and the "before and after" plants.

PETUNIA. Both growers ranked plants in the "after" treatment as the nicest overall, while the consumers ranked the "before and after" plants as the nicest. The rankings of vigor were also split between those two treatments. All evaluators considered the "after" plants to be the most marketable.

VINCA. All evaluators considered the "before" plants to be not only the nicest overall, but also the most vigorous and the most marketable.

So, what did we come away with?

It's no secret that growth, vigor and flowering are the most important factors in bedding plant production. In this trial, all plants treated with Messenger had better growth compared to the control. Most treated plants also were considered more marketable. The greatest impact was found on vinca treated with Messenger.

So, it's worth testing for yourself. ■

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