

# TRENDS AND USES OF PLANT GROWTH REGULATORS ON HERBACEOUS PERENNIALS

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## ABSTRACT

Production of herbaceous perennials has been one of the most rapidly growing areas of floriculture for the last 8 to 10 years. However, greenhouse and nursery production of herbaceous perennials requires a significant effort to control the growth of some of these very vigorous plants. Until very recently the primary methods of control were scheduling and pruning. If a grower missed the target date, he cut the crop back. However, in the effort to keep these plants in balance with their containers and shipping carts, growers have the same arsenal of chemical plant growth regulators (PGRs) that has been used on annual bedding plants and other potted floricultural crops since the early 1960s. Herbaceous perennial growers understand that plant height affects the perceived quality of the plant, i.e., a plant in balance with its container size is of higher quality, which means that these plants are the most saleable. Growers using PGRs to accomplish this height control have fewer production losses due to the more saleable plants as well as the physiological enhancement of stress tolerance, which results in longer shelf-life in the greenhouse or in the retail setting. Another major advantage to growers using PGRs is that more compact plants can be more easily and economically shipped and displayed on typical retail racks. After many years of conducting research on crop responses to a variety of PGRs, we are finally seeing growers testing these methods on herbaceous perennials in their own nurseries.

The primary plant processes that we seek to affect with PGRs in perennial production are growth regulation of plant height and branching. Other chemicals are used in other crops primarily to affect flowering or in propagation of cuttings.

## Controlling Plant Height

*Plant Growth Retardants.* The primary chemicals used to control plant height are gibberellin (GA) inhibitors. The gibberellins are the natural plant hormones that cause the elongation of cells in the plant. They are present in the greatest quantities in those tissues that are elongating the most rapidly, usually stems, petioles, and, in some crops, the flower inflorescences. The PGRs that are used to reduce height are commonly called plant growth retardants. They consist of several older compounds that were introduced to floriculture in 1960s and 70s like B-Nine (daminozide, Crompton/ Uniroyal Chemical Co.) and Cycocel (chlormequat chloride, Olympic Horticultural Products) and A-Rest (ancymidol, SePRO Chemical). These products are still commonly used in the industry. In the 1980s, a new class of compounds was introduced, the triazoles, which include the paclobutrazols, Bonzi (Syngenta Professional Products) and Piccolo (Fine Americas) and uniconazole which is sold as Sumagic (Valent USA). These products are much more potent than the older chemistry. Around that same time, flurprimidol was also being tested in floricultural crops but was not released in the United States for this market. Soon to be released as Topflor (SePRO Chemical), flurprimidol is also a very potent GA inhibitor.

With respect to growth retardant use on herbaceous perennials, all of these PGRs are used in this market. B-Nine or a tank mix of B-Nine and Cycocel is the common starting place for many producers new to using PGRs. These are safer PGRs with more short-term effects on

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growth. Cycocel can cause chlorosis of leaf tissue, but this is less of a problem when used in the tank mix. The negative side of short-term effects is the need to make multiple applications to obtain growth control over a typical four to eight week production season. The tank mix offers higher activity than the additive effect of B-Nine and Cycocel alone. This higher activity provides longer term control with a single application than with B-Nine alone. Spray application rates for the tank mix in the southern parts of the United States are up to 5000 ppm B-Nine with 1500 ppm Cycocel; rates about half this are more typical for northern producers. In our research evaluations, over 50% of the cultivars tested have been responsive to multiple applications of B-Nine; fewer have been evaluated for response to the tank mix.

Growers more familiar with PGRs will more commonly test the more potent compounds like Bonzi, Piccolo or Sumagic to obtain more long-term growth regulation, four to eight weeks depending on crop and rate. Excessive rates can result in landscape persistence of growth reductions. So, experience and in-nursery testing are important to obtaining good results with the more potent PGRs.

A-Rest is an intermediate compound with respect to its activity that is used more commonly by northern producers of perennials where lower rates are applied. A-Rest is the PGR of choice for many plug producers (annuals and perennials) and for certain floriculture crops. However, its cost makes it prohibitive for many of the finished perennials. However, more recent grower and university trials have suggested a synergy between A-Rest and B-Nine, similar to that seen with B-Nine and Cycocel, which will permit its use with lower rates and therefore lower costs.

*Cultivar and Species Responses to PGRs.* One common issue in applying PGRs to herbaceous perennials is the variability of response with different cultivars of the same genus. For example, in the genus *Achillea*, we have tested the response of four hybrid cultivars to Sumagic. Two cultivars, Coronation Gold and Paprika, were responsive to 15 ppm Sumagic or less. The other two cultivars, Moonshine and Summer Pastels, showed no significant growth reductions when treated with 60 ppm Sumagic. Since cultivar response is so variable, it is rightly expected that species variability in response to the various PGRs is also unpredictable. The large number of herbaceous perennials on the market precludes finding rate data on all of them, but there are a few resources to assist producers in identifying starting test rates. First, *Greenhouse Product News* (GPN) magazine hosts a searchable database of our research results of PGRs on herbaceous perennials. That website is <http://www.gpnmag.com>. *Grower Talks* magazine has published a chart of Paul Pilon's grower trials as a section in *Grower Talks on Perennials* (Ball Publishing, Inc). Paul Pilon is the head grower for Sawyer Nursery, a large perennials producer in Hudsonville, Michigan. Paul's rates are based on multiple applications at ~2 week intervals using northern rates, and includes some tank mix information, particularly on Sumagic and B-Nine tank mixes.

*Application Methods.* Before determining an application method, the grower must know how the PGR is taken in by the plant. B-Nine and Cycocel are primarily taken up by the leaves whereas Bonzi, Piccolo, and Sumagic are primarily taken up by the stems and petioles or through the root system. A-Rest is taken up by both leaves and the root system, and Topflor is taken up by leaves, stems and roots. The growth inhibition of soil active PGRs (those taken up by the root system) is significantly affected by the volume of the application and therefore, these PGRs must be applied with more precision than the older, foliar products. Although drench applications are not commonly used with perennials due to the large number of plants, growers are using irrigation systems to apply the PGRs in a "watering-in" process to take advantage of the benefits

of drenches. At this time, only Bonzi, Piccolo, and A-Rest are labeled for application through the irrigation system.

New interest in application methods include a plug or liner dip, wherein the root ball of the propagule is dipped in the PGR solution prior to planting in the final container. This has been successfully used with a variety of crops and is particularly useful in mixed containers where the plants require different levels of growth control. With perennials it is possible to achieve a baseline level of control with a liner dip. Extension growth of Russian sage (*Perovskia atriplicifolia*) was controlled through five weeks after planting with a pre-plant dip of 1 ppm Sumagic or 2 ppm Bonzi. Additional control after this baseline time can be achieved with spray applications where necessary.

### **Increasing Plant Branching**

In general, the perennials have not undergone the extensive plant breeding required to improve plant habit and flowering as have many of the annual bedding plants and potted crops. Therefore, there is interest in chemically inducing the plant to develop a more desirable growth habit that in most cases will also result in an increase in flowering or landscape performance.

*Branching Agents.* Many of the plant hormone-type growth regulators have been used to affect plant branching. Florel Brand Pistill (ethephon, Monterey Chemical Co.) has been used to abort flowers and enhance branching of stock plants and cuttings of many ornamental plants. Its efficacy is affected by many local factors including water quality, degree of environmental stress and plant quality. Researchers have identified a variety of crops responsive to Florel but few perennials have been improved by its use. At Michigan State University, Florel increased the number of flowers in three crops, *Achillea*, *Coreopsis*, and *Phlox*, but decreased the number of flowers in *Echinacea*, *Leucanthemum*, *Monarda* and *Physostegia*, and generally had no effect on the number of branches (Hayashi et al., 2001). Our own work has found variable responses with perennials treated with Florel. Florel was very phytotoxic on *Monarda*, but increased the number of shoots (basal shoots, not lateral branches) on *Verbena rigida*.

Atrimmec (dikegulac sodium, PBI Gordon) is a DNA inhibitor that functionally shuts down the growing points of the treated plant for two to four weeks. It is a very potent branching agent that typically causes chlorosis that can persist for several weeks as well. It is currently labeled for use on lantana, buddleia, and verbena. Brunner et al. (2001) found that a single application of 4350 ppm Atrimmec increased the shoot number up to 133% at ten weeks after treatment while reducing shoot length of 'Goldflame' honeysuckle. We found similar results with 800 ppm Atrimmec increasing branching of *Clematis* hybrids and *Verbena rigida* while reducing plant height (Puglisi and Latimer, unpublished). We are currently exploring using Atrimmec in the fall just before dormancy to see if we can improve spring branching without the delay in crop production.

The gibberellin and cytokinin products have been widely tested in their effects on ornamentals. Fascination (Valent USA) and Fresco (Fine Americas, Inc.) contain equal parts 6-benzyladenine + GA<sub>4+7</sub>. These products have enhanced branching of *Clematis* hybrids and *C. jackmanii* but the increased shoot length is a hindrance to efficient nursery production of the crop. Benzyladenine alone has been effective in some crops like hosta which produces significantly more offsets with treatment (Keever, 1994). We are currently evaluating two commercial cytokinin products, BAP-10 (Plantwise Biostimulants Co.) and Exilis (Fine Americas, Inc.) on a variety of perennials. In addition, new compounds are being made available for additional research into enhanced plant branching. We expect to see new products and new

labeling for existing products in this area over the next few years. This is a relatively untapped market area with very large potential production numbers.

#### **LITERATURE CITED**

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