

FORCING PERENNIALS

Editor's note: Michigan State University and GREENHOUSE GROWER bring you our third series on forcing perennials to flower.

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CONTROLLING plant height and manipulating the flowering date can be difficult in the commercial production of potted herbaceous perennials. Height control is important because tall plants can become top-heavy and floppy and therefore more expensive to ship. Manipulating the flowering date is also important to avoid overconcentration of flowering plants on a single date and extend shipping and sales beyond the natural flowering period.

Ethephon, an ethylene-releasing compound sold under the trade name of Florel, has been successfully used to retard stem elongation and manipulate the flowering date of several plants such as geraniums and New Guinea impatiens. Ethephon affects plant height following absorption because it breaks down into ethylene, and one response to ethylene in plants is the reduction of cell elongation.

Ethephon through ethylene release can also inhibit flower initiation and cause abortion of young flowers of many species.

Many herbaceous perennial species flower within a limited period of time when forced in a greenhouse or outdoors. If ethephon could be used to successfully delay flowering of herbaceous perennials without completely eliminating flowering, this might permit growers to schedule shipping past normal flowering dates.

Methods

We applied Florel to eight plant species to determine if it might effectively regulate plant height and flowering. Species treated were *Achillea millefolium* 'Weser River Sandstone,' *Coreopsis verticillata* 'Moonbeam,' *Echinacea purpurea* 'Bravado,' *Leucanthemum x superbum* 'Thomas Killen,' *Liatris spicata* 'Kobold,' *Monarda didyma* 'Blue Stocking,' *Phlox paniculata* 'Mt. Fuji,' and *Physostegia virginiana* 'Summer Snow.'

Plants in eight-inch pots were forced in a fan-and-pad cooled greenhouse starting in mid-June under natural light plus a four-hour night interruption by high-pressure sodium lamps. Sprays of Florel at 500 and 1,000 ppm were applied once, twice, or three times at two-week intervals by



Figure 1. *Achillea millefolium* 'Weser River Sandstone' showed about 20% height reduction by Florel treatment. Number of inflorescences per pot was increased an average of 20% by Florel.



Figure 2. *Echinacea purpurea* 'Bravado' responded dramatically to Florel. Florel reduced plant height about 40% and delayed flowering up to six days.

using a hand-held sprayer to uniformly wet plant foliage and stems.

Flowering Time And Plant Height

The effects of Florel on plant height and flowering varied among species. Florel reduced height at first flower of achillea (Figure 1), echinacea (Figure 2), leucanthemum (Figure 3), monarda (Figure 4), and physostegia (Figure 5). Plant height for these species was reduced 23%, 42%, 46%, 40%, and 46%, respectively, when Florel was applied three times at 1,000 ppm.

Final plant height of liatris (Figure 6) decreased up to 28%, but there was no significant difference between the mean value of treatments and that of the control because

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some treated plants responded only slightly to Florel.

Overall, Florel had little effect on flower timing of the tested herbaceous perennials. Spraying Florel three times at 1,000 ppm only delayed flowering of echinacea, monarda, and physostegia by six, seven, and nine days, respectively. Although not statistically significant, flowering time was delayed up to five and seven days in phlox (Figure 7) and liatris, respectively, on plants sprayed three times at 1,000 ppm.

Generally, the magnitude of Florel's effect on plant height and flowering time was in proportion to the applied dose. Height and flowering were increasingly reduced and delayed as application number and concentration increased.

Flower Number

Florel has been used as a branching agent for decades because it promotes axillary shoot development without killing the apical meristem or growing point. In this experiment, Florel promoted or suppressed branching, depending on the species. The number of inflorescences per pot was increased by Florel application in achillea, coreopsis, and phlox, while it was decreased in echinacea, leucanthemum, monarda, and physostegia.

Achillea, coreopsis (Figure 8), and leucanthemum had already initiated inflorescences when first sprayed with Florel at the experiment's start. In contrast to its effects on plants like geranium and New Guinea impatiens, Florel did not abort these flowers, even when applied three times at 1,000 ppm.

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Figure 3. Final plant height of *Leucanthemum x superbum* 'Thomas Killen' was decreased up to 46% by Florel treatment. See also Figure 9.

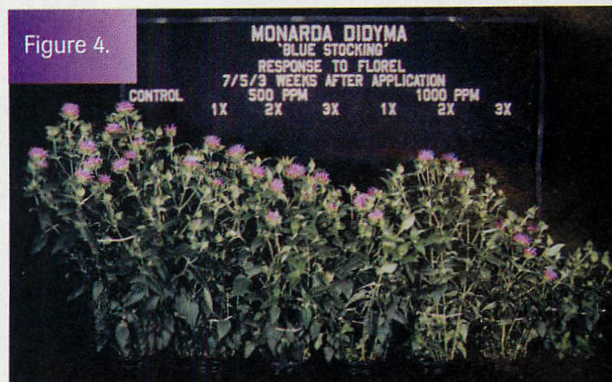


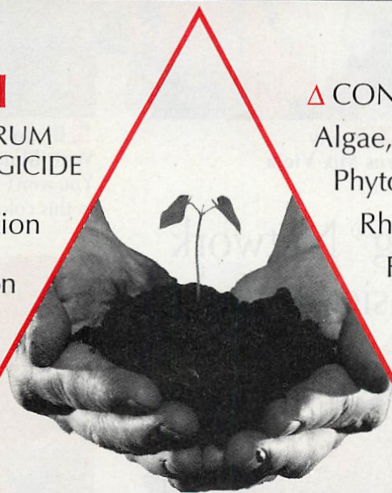
Figure 4. Florel was useful for regulating plant height and flowering of *Monarda didyma* 'Blue Stocking.' Number of inflorescences per pot was greatly decreased by Florel.

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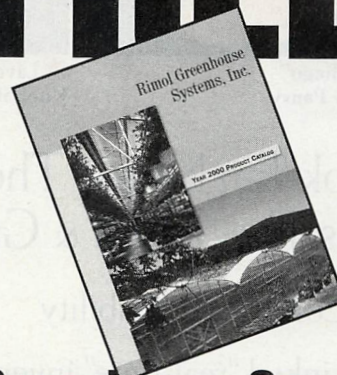
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Flower Size

Florel reduced the inflorescence size in echinacea and leucanthemum (Figure 9) in proportion to the amount applied. Three applications of Florel at 1,000 ppm resulted in poor-looking leucanthemum plants with small inflorescences.

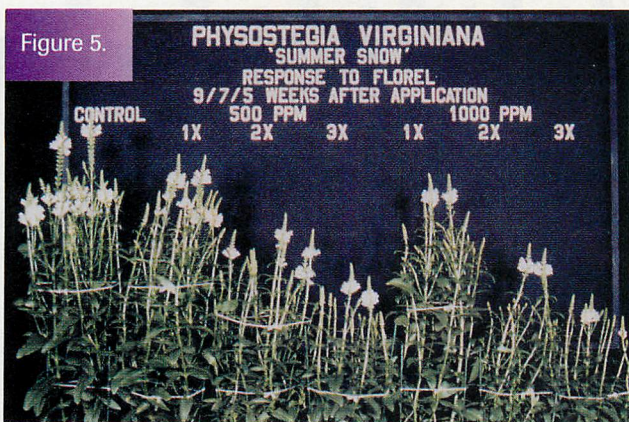


Figure 5. Plant height of *Physostegia virginiana* 'Summer Snow' decreased linearly with increasing concentration and the number of Florel applications. Flowering was delayed up to 10 days in proportion to the number of Florel applications, regardless of concentration.

Plant Uniformity

Liatris, *echinacea*, *leucanthemum*, and *physostegia* had individual plants that did not respond to Florel. We speculate that the nonresponse was caused by nonuniform genetics among plants in these species. It is possible that *lack of* genetic uniformity may result in variable responses to Florel among plants of the same cultivar.

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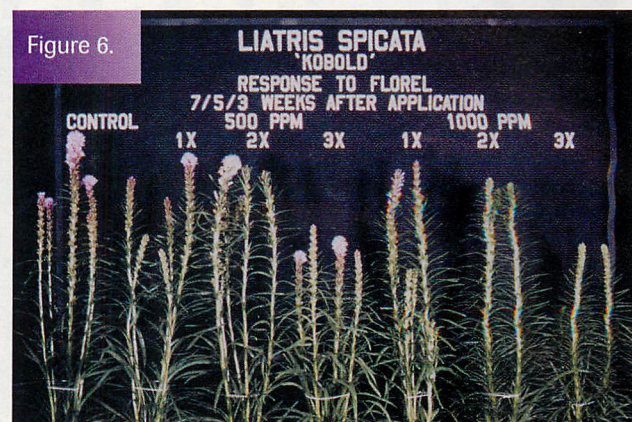
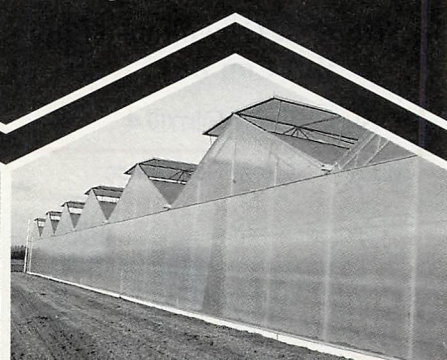


Figure 6. Response of *Liatris spicata* 'Kobold' to Florel was highly variable among plants. Time to flower tended to increase as Florel application dosage increased. Although not statistically significant, final plant height tended to decrease as Florel dose increased.

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Plant Form

The amount of Florel a plant absorbs from a spray treatment is a function of surface area of the plant body, that is, total leaf area. Therefore, besides concentration and the number of applications, plant form and application method may be important. Plants with small leaves like coreopsis 'Moonbeam' may absorb less solution, which may partly account for the small stem-elongation response to Florel application.

Phytotoxicity

Florel at 1,000 ppm caused severe phytotoxicity on the young foliage of monarda (Figure 10); therefore we do not recommend Florel application to monarda. Phytotoxicity was not observed on other plant species.

Application rates and frequency may be altered based upon the differences in species, desired time to flower, and final plant height as well as climate and culturing methods. Our suggested application dose and the factors or responsiveness to consider are as follows:

Application concentration. If you do test Florel on herbaceous perennials under high-temperature summer conditions similar to that of our experiment, we suggest the application rate initially be made at 1,000 ppm and then adjusted according to your evaluation. Although not evaluated, concentrations higher than 1,000 ppm may be necessary to control the height for achillea and phlox, while lower concentrations may be suitable to increase attractive-

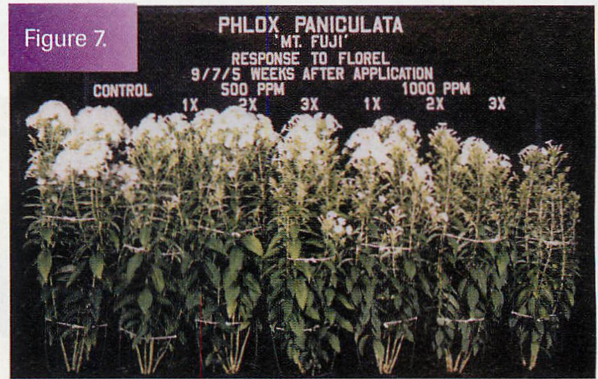


Figure 7. *Phlox paniculata* 'Mt. Fuji' responded slightly to Florel. Higher concentrations will be necessary to control *Phlox paniculata* height.

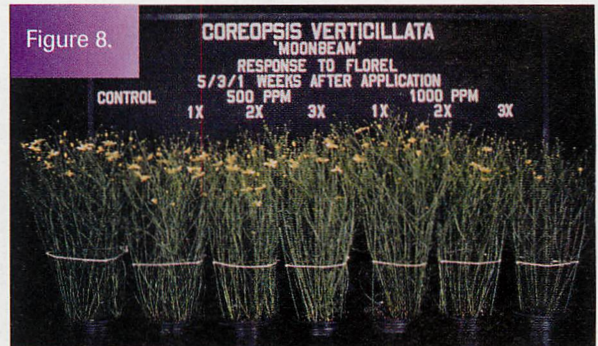


Figure 8. *Coreopsis verticillata* 'Moonbeam' did not respond to Florel.

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ness for leucanthemum and monarda.

Because these experiments were conducted during summer, we do not know the application's effects during winter and spring. Rates lower than 1,000 ppm should be tested during these seasons.

Application Frequency. A two-week interval between Florel applications was suitable as judged from our observations on Florel's effect on stem elongation. We do not know if longer-interval applications at a higher concentration or short-interval applications with a lower concentration will work equally well.

Florel's Fate

Our initial goals were to determine if Florel would delay flowering and decrease stem elongation in herbaceous perennials. Even with three 1,000-ppm applications, flowering was not delayed more than nine days for any species. Therefore, we do not believe Florel, at least at the rates and frequency applied, will be a feasible method of delaying flowering in these herbaceous perennials as it is in crops like zonal geraniums or New Guinea impatiens.

Stem elongation in most species tested was reduced by Florel applications. Therefore, Florel could be used as an alternative to other growth retardants for height control. High dosages, however, must be avoided because flower size can be adversely affected in some species (Figure 9). **GG**

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Figure 9. Florel reduced the inflorescence size in leucanthemum in proportion to the amount applied.



Figure 10. Florel at 1,000 ppm caused severe phytotoxicity on the young foliage of monarda.

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