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# Using PGR Liner Soaks for Early Growth Regulation

*Liner soaks offer an excellent means of getting growth control of vigorous crops early in the production cycle.*



Growers are asking how to control of vigorous crops early in the production cycle with plant growth regulators (PGRs). Liner soaks may be the perfect application method. Liner soaks involve saturating a plug or liner root ball with a growth retardant solution. The rapid uptake of the PGR through the root system gives very rapid growth regulation as you can see with the growth control of the *Gaura* 'Pink Fountain' just two weeks after being treated with Piccolo 10 XC (paclobutrazol) liner soaks of 0, 1, 2, 4, or 8 ppm (Figure 1).

There are other advantages to using liner soaks over other types of PGR application methods. You can soak the plants one day and plant them later, at a more convenient date, such as after the restricted entry interval (REI) for the treatment has passed. You also can use liner dips to treat vigorous plants used in mixed containers without affecting the surrounding plants. Liner soaks are generally very effective, economical

and safe to apply, and the application can be automated in larger greenhouse operations.

## PGRs and Rates to Test

Liner soaks are effective with any of the soil active PGRs, i.e., PGRs that are absorbed by plant roots, but paclobutrazol (Bonzi, Downsize, Paczol, Piccolo, and Piccolo 10 XC) and uniconazole (Concise and Sumagic) are most commonly used. In general, select rates that provide "baseline" control. In other words, these rates should provide



Figure 1. *Gaura lindheimeri* 'Pink Fountain' liners soaked for two minutes in Piccolo 10 XC (paclobutrazol) solutions of 0, 1, 2, 4, or 8 ppm the day before potting into quart pots. Photo taken two weeks after treatment.

## e-GRO Alert

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early season growth control but not persist too long if the growing conditions are not as good as expected. Additional PGR treatments can be applied later in the season if necessary.

### Annuals.

Researchers from Michigan and Purdue have published liner soaks rates for a variety of annual liners/plugs. Paclobutrazol is generally applied at 4 to 12 ppm, depending on the vigor of the crop and cultivar. Note in Table 1 that some crops, like ‘Blackie’ sweet potato vine, require much lower rates. However, in later trials, researchers found that ‘Marguerite’ sweet potato vine was not responsive to up to 16 ppm Piccolo applied as a liner soak while ‘Black Falls’ was highly responsive (Currey and Lopez, Greenhouse Grower, September 2011).

Uniconazole is used at much lower rates. Michigan recommendations are 1 to 4 ppm for most of the vegetative annuals. In general these rates will provide 6 to 8 weeks of growth control.

Table 1. Suggested Piccolo (paclobutrazol) liner soak rates for six plant species studied based on growing conditions in Michigan in late spring (used with permission from : Dr. Roberto Lopez. Plant Growth Regulator Liner Dips. FloriBytes Year III. Issue 2 May 2008.)

Species	Suggested Piccolo Rates
<i>Bacopa</i> ‘Falls Big Pearl’	4 to 8 ppm
<i>Coleus</i> ‘Stained Glassworks Copper’	6 to 10 ppm
‘Blackie’ sweet potato vine	1 to 3 ppm
Cape daisy ‘Side Show Bicolor Pink’	4 to 8 ppm
<i>Petunia</i> ‘Multiflora Prostrate Wave Purple’	12 ppm
<i>Verbena</i> ‘Semi Trailing Escapade Bright Eye’	8 to 12 ppm

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In various venues, we have presented the results of some of our Virginia Tech work with liner soaks, especially with crops that are difficult to control with foliar PGR sprays.

In ornamental grasses, for example, *Miscanthus* and *Calamagrostis* are not very responsive to foliar sprays of uniconazole. Liner soaks of 1, 2, or 3 ppm Concise applied for two minutes to liners that were ready for irrigation gave excellent control of *Miscanthus* 'Gracillimus' height (Fig. 2). Growth of plants treated with higher rates, 4 or 5 ppm, was essentially shut down about four weeks after treatment (WAT), and plants did not grow out of the treatment over the 12-week test.

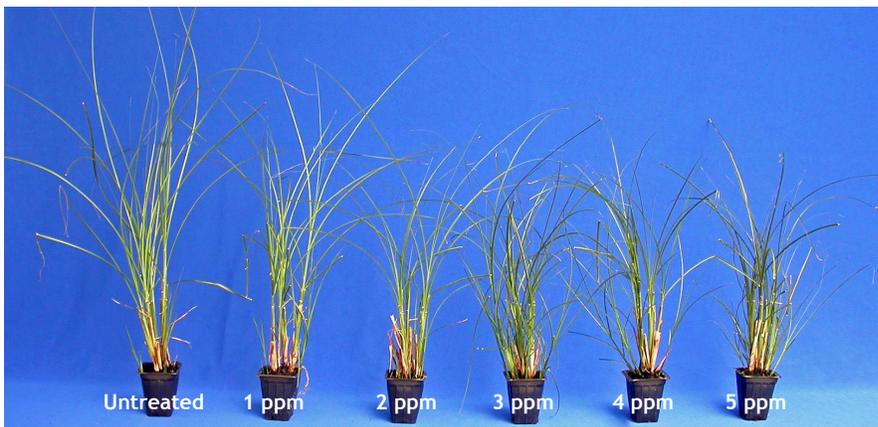


Figure 2. *Miscanthus sinensis* 'Gracillimus' liners soaked for two minutes in 0, 1, 2, 3, 4, or 5 ppm Concise (uniconazole). Liners were held in their original 3.5-inch liner pots. Photo taken eight weeks after treatment. (Thanks to Poplar Ridge Nursery, Warsaw VA for plants)

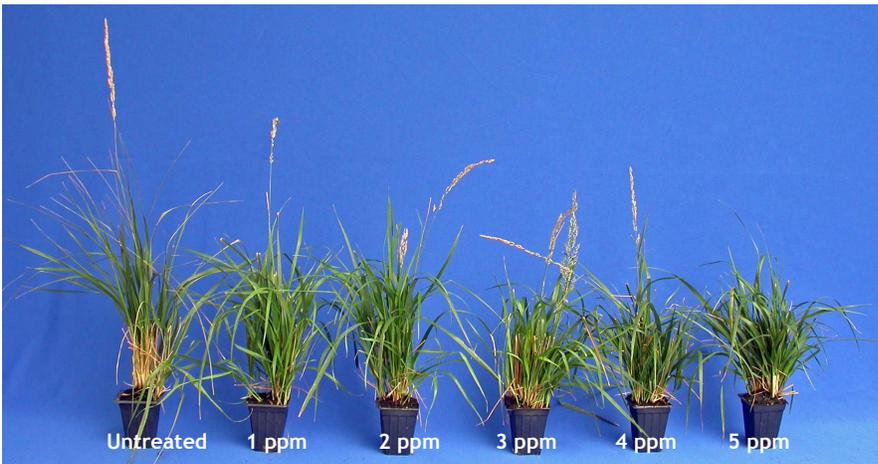


Figure 3. *Calamagrostis x acutifolia* 'Karl Foerster' liners soaked for two minutes in 0, 1, 2, 3, 4, or 5 ppm Concise (uniconazole). Liners were held in their original liner pots. (Thanks to Poplar Ridge Nursery, Warsaw VA for plants)

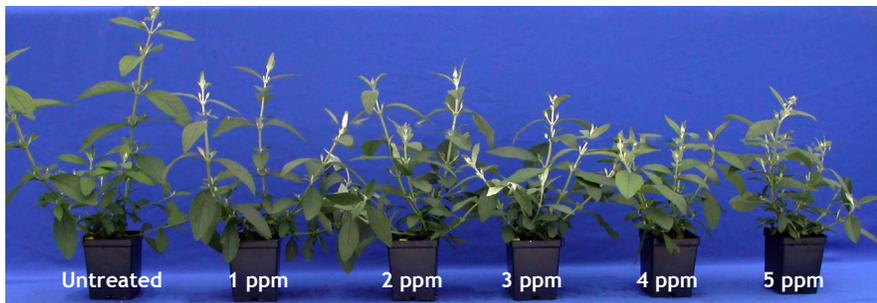


Figure 4. *Buddleia weyeriana* 'Honeycomb' liners soaked for two minutes in Sumagic (uniconazole) solutions of 0, 1, 2, 3, 4, or 5 ppm the day before potting into quart pots. Photo taken at four weeks after treatment.



Figure 5. *Rudbeckia* 'Goldsturm' liners soaked for two minutes in Concise (uniconazole) solutions of 0, 1, 2, 3, 4, or 5 ppm the day before potting into quart pots. Photo taken at six weeks after treatment.

The rate response of *Calamagrostis* 'Karl Foerster' was saturated at about 2 ppm Concise; higher soak rates did not result in a significant amount of additional growth control (Fig. 3). In the liner trays, Concise gave significant growth control through 12 WAT in both grasses. Sensitivity to control varied with the grass species. Uniconazole rates of 1 to 2 ppm are recommended, depending on the grass species and how long growth control is desired.

*Buddleia* is another crop that is not very responsive to PGR sprays but was moderately responsive to Sumagic liner soaks. *Buddleia weyeriana* 'Honeycomb' liners soaked in solutions of 0, 1, 2, 3, 4, or 5 ppm Sumagic produced plants about to flower and still in balance with quart pots at 4 WAT (Fig. 4).

*Rudbeckia* 'Goldsturm' is very responsive to uniconazole. Plant height was reduced with increasing rates of the Concise liner soaks at 6 WAT (Fig. 5). Concise at 1 ppm provided significant control of plant height without excessive reductions in plant width or a delay in flowering. Higher dip rates caused excessive growth reduction and delayed flowering.

*Gaura* 'Pink Fountain' height was reduced up to 44% with liner soak rates at or above 2 ppm Piccolo 10 XC at 4 WAT (Fig. 6a). Only an 8 ppm liner soak resulted in plants that appeared stunted at 6 WAT (Fig. 6b). Plant width was also decreased with the liner dips. In addition, the plant growth habit was more upright than in control plants, which was more attractive for marketing the plants. Piccolo 10 XC liner soaks did not affect the percentage of plants flowering or the number of days required for first flower. Reviewing the growth control at 2 WAT (Fig. 1) and 4 and 6 WAT (Fig. 6ab) provides a good example of growth regulation throughout the production cycle with a single liner soak, at an appropriate rate.

Other crops in this Piccolo 10 XC liner soak trial included *Monarda* 'Raspberry Wine' and *Penstemon* 'Laura,' which were much less responsive to paclobutrazol liner dips, with significant, but short-term, growth control only with a 16 ppm Piccolo 10 XC rate. The appearance of these plants was excellent, and the liner dip provided the baseline control that we desired. Holding these crops longer than about four weeks,

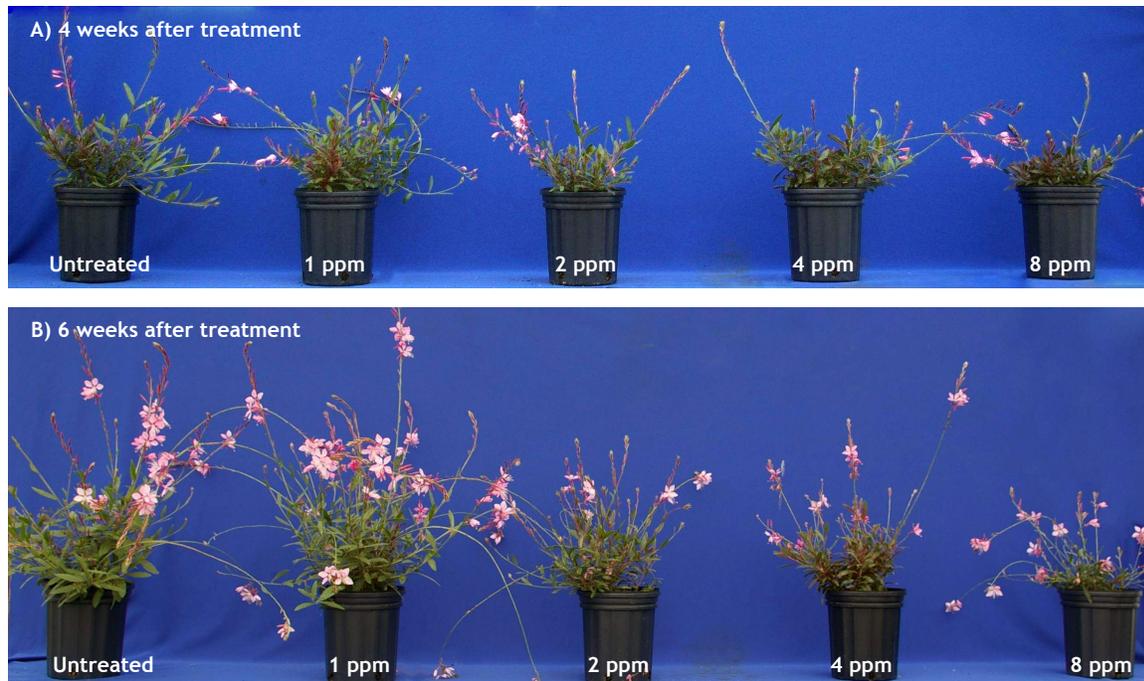


Figure 6. *Gaura lindheimeri* 'Pink Fountain' liners soaked for two minutes in Piccolo 10 XC (paclobutrazol) solutions of 0, 1, 2, 4, or 8 ppm the day before potting into quart pots. Photo taken at A) 4 weeks after treatment or B) 6 weeks after treatment.

however, would require a higher initial liner soak rate or a subsequent PGR spray application. *Veronica* 'Pink Panther' was also responsive to liner soaks of Piccolo 10 XC with moderate height control through 8 WAT with 4 or 8 ppm. These non-vernalized *Monarda* and *Veronica* plants did not flower during the trial, but there was no treatment effect on flowering of *Penstemon* 'Laura.'

In summary, liner dips offer an excellent opportunity to get early control of vigorous herbaceous perennials. Increasing PGR rates will give longer term control. Without specific cultivar recommendations, low rates, 2 to 4 ppm paclobutrazol or 0.5 to 1 ppm uniconazole are good starting rates for short-term control. But notice in the examples above that some of these more vigorous crops may require liner soak rates greater than 16 ppm paclobutrazol or 3 to 4 ppm uniconazole.

Like all PGR treatments, the success is in the development of a consistent and repeatable application technique under your own operational conditions. Remember that growth retardant rates for liner soaks will vary in different parts of the country just like your spray rates. Do your own trials and keep records of the responses and the environmental conditions during and after the treatment. Plant growth regulation is still a combination of art and science.

### **Guidelines for Liner Soaks**

So, to summarize, the application guidelines for liner soaks are pretty simple. Develop your own consistent protocols based around these guidelines - with an emphasis on consistent.

- Liners/plugs should not be under drought stress, but should be ready for irrigation. The normal variability across the flat is not a problem.
- The length of the soak time should be between 30 seconds and 2 minutes - be consistent. The goal is to saturate the root ball. In fact, saturating the root ball with a drench application will accomplish the same growth control but is a less efficient use of the chemical.
- Younger liners/plugs (less well rooted) appear to be more responsive than older liners. You may need to reduce your rates for younger plugs.
- Treated plants may be held in the flat for several days without affecting the growth control.
- The leftover soak solution is still safe and effective to use as a drench on other appropriate plants.