# Factors Affecting PGR Liner Dips

If you're getting variable results from PGR liner dips, you can't afford to miss this University of Florida research.

**By Rebecca Schnelle, Christopher Cerveny and Jim Barrett**

The "liner dip" is a new and effective method for applying plant growth regulators (PGRs). It is an efficient way to treat large numbers of plants with minimal labor and chemical. Liner dips can be particularly beneficial for very vigorous crops that tend to grow rapidly immediately following transplant. In addition, liner dips allow different PGR rates to be applied to plants before planting in a mixed container, which helps to even out vigor and produce a more attractive finished product.

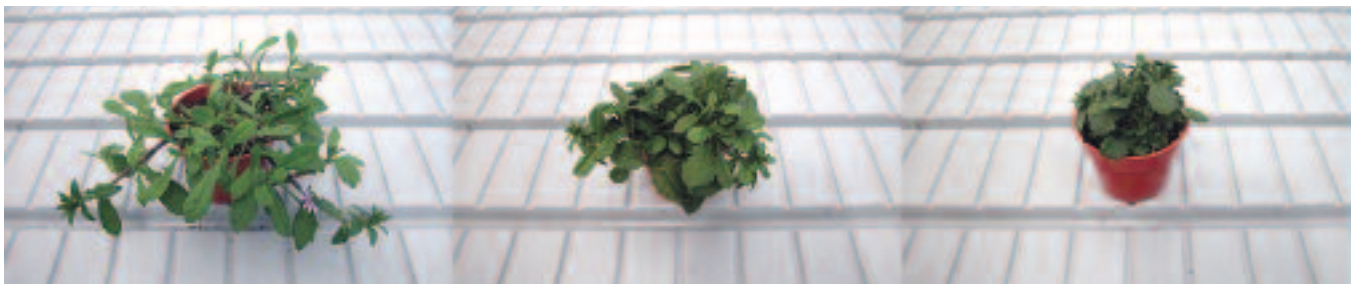
While this technique has been shown to be quite effective, many growers have reported inconsistent size control with liner dips. We have observed variable responses in our research trials as well. Through conversations with growers, other researchers and our observations, we identified several possible sources of inconsistency in liner dip activity. Over the past two years, we conducted a series of experiments investigating these factors, and this article presents examples of how the following seven factors affect liner dips:

- rate of PGR in solution,
- time the liner is in the solution,
- moisture level of the liner at time of treatment,
- light level during the treatment,
- depth of the solution,
- time from treatment to transplant and
- age of the cuttings (degree of rooting).

## GENERAL INFORMATION

Liner dips can be carried out in several ways with any of the PGRs that are active in the media. For larger scale production, mechanized dipping using a conveyer and trough is an efficient procedure. When smaller numbers of liners are to be treated, as was the case in our experiments, hand dipping in a trough or tray is a more practical method. We used standard trays containing 1 gal. of the PGR solution, except in the solution depth experiment. Unless otherwise noted, all liners were dry at the time of treatment and dipped for 30 seconds in a high light greenhouse environment. With the exception of the time to transplant experiment, all liners were planted the same day as the treatment.

Paczol (paclobutrazol, Cromp-ton Corp.) was used in experiments conducted in the spring of 2005 with commercially produced and fully rooted liners. Sumagic (uniconazole,Valent USA) was used in experiments conducted spring and ➧



*Scaevola 'Sapphire' treated with a Paczol liner dip. Left to right: 0 ppm, 1 ppm and 4 ppm. (Photos courtesy of University of Florida)*

*Petunia 'Dreams Rose Picotee' treated with a Paczol liner dip. Left to right: 0 ppm, 2 ppm and 8 ppm.*

*Calibrachoa 'Celebration Sun' treated with a Paczol liner dip. Left to right: 0 ppm, 4 ppm with wet liner media and 4 ppm with dry liner media.*

summer of 2004 with cuttings rooted onsite. The size measurements are an average of plant height and width.

## RATE EXPERIMENT

The rate of growth regulator applied is obviously an important factor in the performance of any PGR treatment. Liner dips are no exception. A strong rate-response was observed in all of our effective liner dip experiments. However, how the crop responds to increasing the rate varies with plant species. Compare scaevola 'Sapphire', pictured p. 20, and petunia 'Dreams Rose Picotee', pictured p. 20. Scaevola is more sensitive to Paczol and shows a dramatic reduction in size as the rate increases. Petunia is less responsive to Paczol, even at twice the rate used in scaevola. This situation is not unique to the liner dip applications. The same type of response can also be observed in spray and drench applications. PGR "eggheads" refer to this as the dose-response-curve and typically the more responsive the crop the steeper the curve; the less responsive crops have a flatter response curve with increasing dose.

## LINER MOISTURE LEVEL

Moisture level of the media at the time of dipping affects the activity of PGR liner dips because moisture level is a major factor influencing the amount of dip solution that is taken up and thusly made available to the roots. Wet liners absorb significantly less of the PGR solution during the brief dip time than dry liners. The effect of liner moisture level is illustrated by the calibrachoa 'Celebration Sun' pictured on page 20 and the petunia 'Avalanche Red' pictured on page 25. In these examples, rooted cuttings that were dry when dipped in Paczol produced much smaller plants four weeks after planting than those treated wet.

In the two experiments, we watered the "wet" treatment one hour before the dip and the "dry" treatment was allowed to dry down for at least 24 hours. The media for the dry plugs was dry to the touch and most of the plants were wilted. However, we don't recommend drying plugs to wilt ➧

*Figure 1. Coleus 'Aurora Chocomint' treated with a Sumagic liner dip 1, 6, 12, 24 or 48 hours after irrigation.*

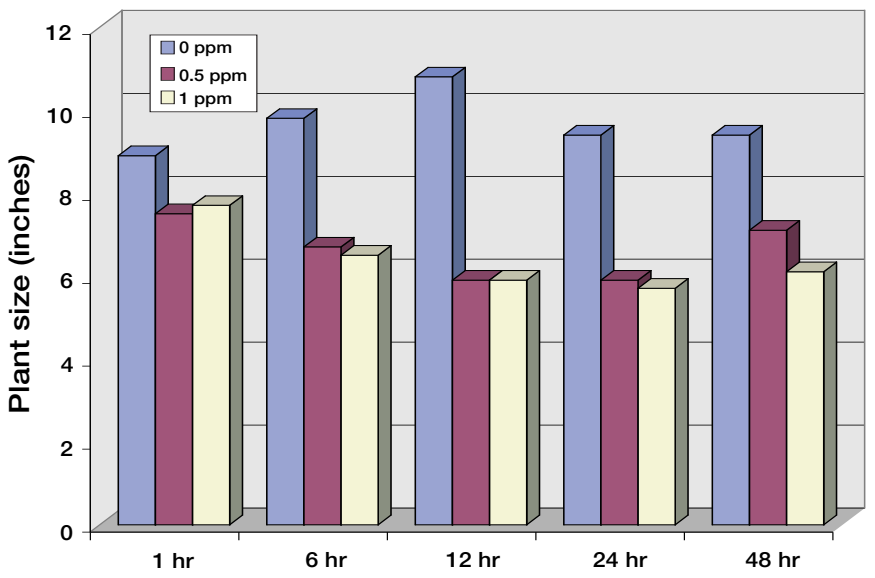
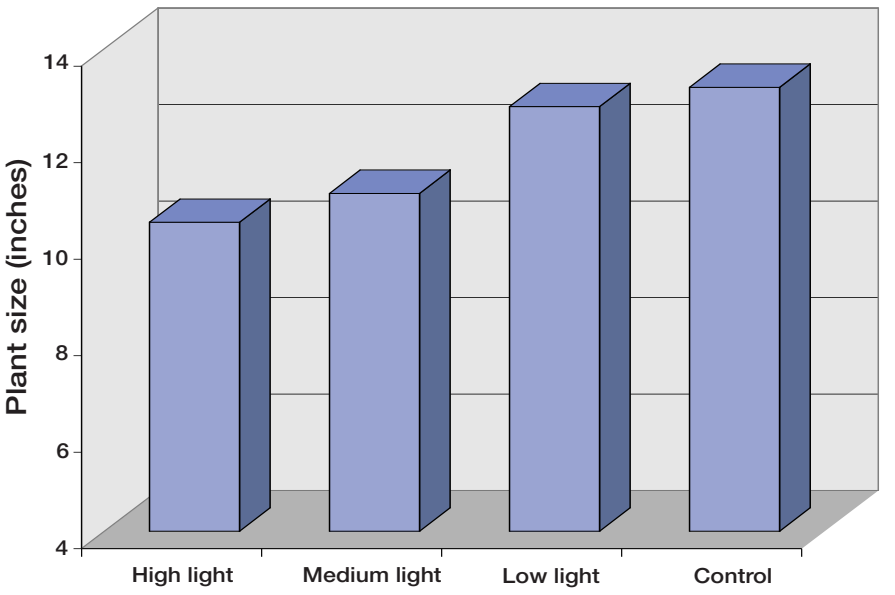



*Figure 2. Petunia 'Tidal Wave Red' dipped in 2 ppm of Paczol with high, medium and low light levels at the time of treatment.*





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due to the fact that they are shut down and little transpiration is occurring during the dip process (see the discussion below on light level effects). We have found that the best activity comes from dipping plugs that are moderately dry but not wilted. Notice in Figure 1, page 22, size control improved as liners were allowed to dry for 6, 12 or 24 hours, but this trend reversed at 48 hours.

## DIP TIME

In addition to the moisture level in the rooting media, the amount of time the liner remains in the dip solution can potentially affect the volume of solution absorbed by the media and the size control achieved. In this example, both wet and dry plugs of scaevola 'Sapphire' were dipped in a 4 ppm Paczol solution for 30 seconds or two minutes.

Four weeks after planting, plants from the liners that were dipped dry for two minutes were smaller with less internode elongation than the ones dipped for 30 seconds. For the liners dipped wet, the PGR had little effect, and there was no size difference between plants in the two dip time treatments, which is another illustration of the affect of media moisture on activity of PGR liner dips.

This pattern of size control indicates that dip time can be a factor in the activity of PGR liner dips. In our studies, we have found that in some cases dip time was a factor but in others it was not. The best policy is to keep dip time consistent whether it is 30 seconds, two minutes or even five minutes. In situations where liner dipping will be done by hand, a timing mechanism will be beneficial to prevent dip time variations. Mechanized liner dipping

*Figure 3. Double impatiens 'Fiesta Pink Ruffle' following a Sumagic liner dip. Depth of the dip was either 2.25 inches (to the top of the media), 1.25 inches (to the middle of the plug) or 0.5 inches.*

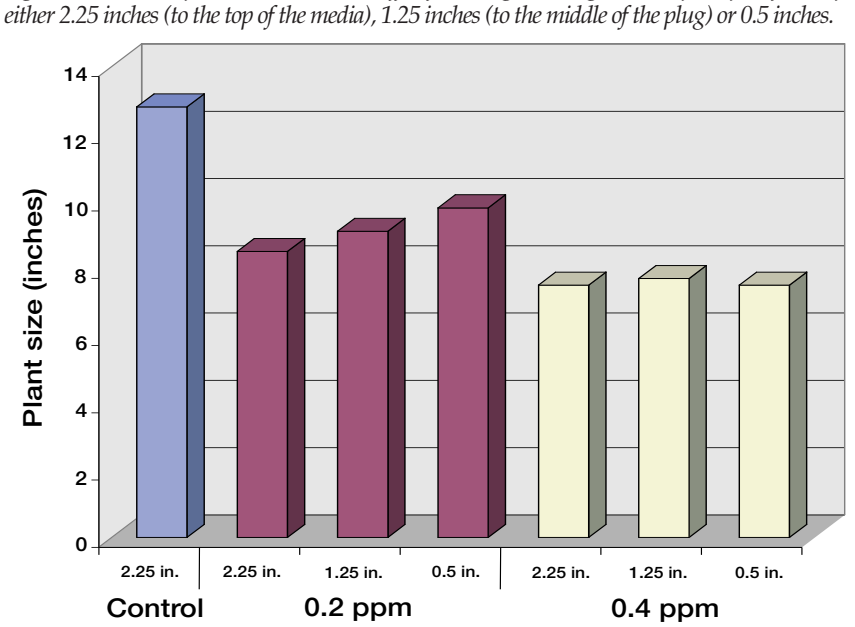
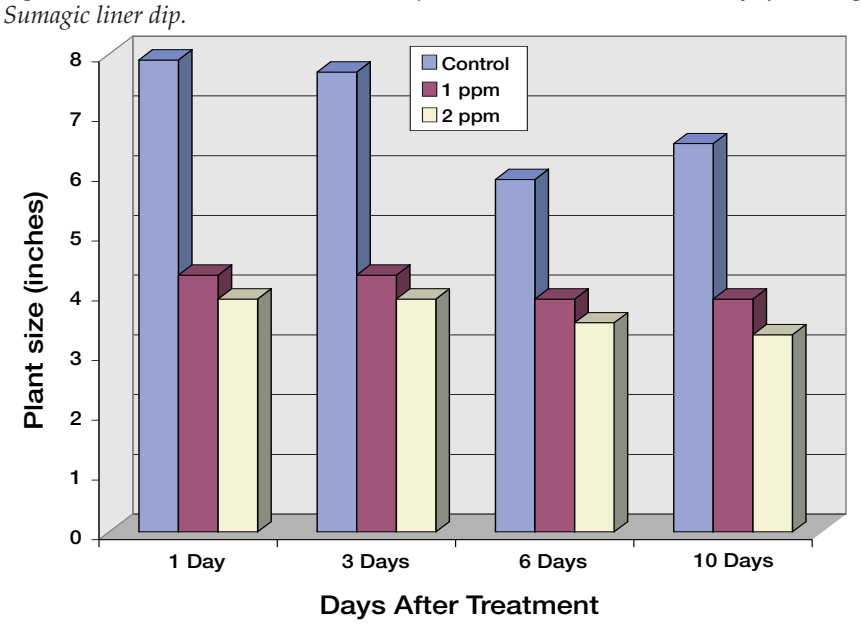



*Figure 4. Calibrachoa 'Starlette Yellow' planted one, three, six or 10 days following a Sumagic liner dip.*



*Petunia 'Avalanche Red' treated with a Paczol liner dip. Left to right: 0 ppm, 8 ppm with wet liner media and 8 ppm with dry liner media.*

apparatus should also be configured to produce sufficient and consistent dip times.

## LIGHT LEVEL AT TREATMENT

Growers have indicated that despite using similar rates and dipping procedures they were experiencing very different results with liner dips. One common variation in dip procedure was location, some growers preferred to carry out the treatments indoors (potting shed or head house) while others performed the dips directly in the greenhouse. There seemed to be more problems with lower than expected response to the PGRs when treatments were done in low light conditions as in a potting shed.

Joyce Latimer at Virginia Tech was the first to ask the question, "Does light level make a difference?" To answer this question, we put dry plugs of petunia 'Tidal Wave Red' in three different environments two hours before the liner dip and left them there two hours after the liner dip. The high light level group was kept in a high light greenhouse, the medium light level group was placed on a bench under 80 percent shade cloth, and the low light level group was placed indoors under standard fluorescent lighting. The results are shown in Figure 2, page 22. The activity of the 30-second dip in Paczol at 2 ppm was significantly greater in the cuttings dipped under high light conditions. The effect was greatly reduced on cuttings dipped indoors.

From this example and other studies, we now feel that the light environment during and shortly after the dip procedure can have a significant effect on the activity of the PGR. Light level is likely affecting the transpiration rate of the plants at the time of the liner dip. With high light and high transpiration conditions, more of the PGR will be taken up by the roots and yield more effective size control. Consequently, any environmental factors that affect transpiration rate may also affect the activity of PGR liner dips.

We suggest that if at all possible liner dips should be carried

*continued on page 106*

*"Liner Dip" continued from page 25*

out in a high light environment to ensure the plants are actively transpiring and will readily take up the active PGR. If liner dips must be done in low light conditions, as in a potting shed, a higher rate will be necessary to compensate for the likely reduction in solution uptake.

## ROOTING QUALITY

For a number of reasons, the amount of root development on cuttings can vary widely at the time of planting and can affect the plant's response to liner dip treatments. Cuttings of double impatiens 'Fiesta Pink Ruffles' (pictured below) were stuck in 124 cell plug trays. Liner dip treatments of 0.2 ppm Sumagic were carried out at either two or four weeks after sticking. The Sumagic dips reduced growth after transplanting in both the plants dipped after two weeks in propagation and those treated after four weeks of propagation. However, the PGR effect was much greater in the group dipped at two weeks.

Due to the differences in age of cuttings used in production, rooting quality could be a major source of variability in liner dip activity. We have not investigated this situation in great detail and are not certain of what is occurring. The variability may be caused by the younger cutting taking up more of the solution via the younger roots, which are likely growing more rapidly than those of a four-week old cutting that is hardened off. It also may be that the less well-rooted cutting will grow through the PGR laden media longer than the older cutting where the roots will move out into the fresh media quickly after transplant.

## SOLUTION DEPTH

"How deep should the dip be?" is a common question that growers ask. One would assume that the deeper the roots and media are dipped in the PGR solution the greater the activity, but our findings were not so straight foreword. For this experiment, liners of double impatiens 'Fiesta Pink Ruffle' were dipped in solutions of 0.2 or 0.4 ppm Sumagic to depths of 2.25, 1.25 or 0.5 inches, which corresponded with the top, middle and bottom of the liner cell. Notice in Figure 3, page 24, that regardless of how deep the liners were in the solution, the Sumagic was very active, and good size control was achieved. There were some differences in size control with the 0.2-ppm rate, but no real difference with the higher 0.4-ppm rate.

At this point, it seems that there is some potential for depth to be a factor in the activity of liner dips, but it does not appear to be as important as other potential factors. This will make the liner dip procedure easier for growers since precise control of solution depth will not be necessary.

*Double impatiens 'Fiesta Pink Ruffle' following a Sumagic liner dip at 0.0 ppm (left) or 0.2 ppm (right); treated and planted two weeks after sticking unrooted cuttings in propagation.*

*Double impatiens 'Fiesta Pink Ruffle' following a Sumagic liner dip at 0.0 ppm (left) or 0.2 ppm (right); treated and planted four weeks after sticking unrooted cuttings in propagation.*

## TIME FROM TREATMENT TO PLANT

People have suggested that the amount of time between treatment and planting could affect the activity of liner dips. The thought here is that immediate planting and watering-in after treatment may leach the active ingredient out of the liner media before it can be taken up by the roots. Conversely, there are concerns that leaving treated plants in the plug trays for extended periods could also reduce activity. Calibrachoa 'Starlette Yellow' liners were treated with a liner dip (1.0 ppm or 2.0 ppm Sumagic) and then planted 1, 3, 6 or 10 days later. The treated plants were all smaller than the controls four weeks after planting (see Figure 4, p. 24). The length of time from treatment to planting did not have a significant impact on plant size in any treatments. This indicates that it is not necessary to plant liners immediately after treatment, which allows more flexibility.

## RECOMMENDATIONS

Due to the number of factors that can cause variability in the activity of PGR liner dips, a key to ensuring consistency in results is developing a practical system to standardize as many of these factors as possible. By being as consistent as possible in terms of the light environment, media dryness, age of the cuttings and dip time, one can concentrate on PGR rate and adjusting rates based on the optimums for various crops.

In this series of experiments, we observed a common trend towards increased variation when lower PGR rates were used. A high enough rate, likely can overcome many of the interacting factors in liner dip activity, and for better uniformity, it is probably best to select rates on the higher end of the optimum range for individual crops.

At this point, we recognize the need for further investigation of these and possibly other factors that may contribute to liner dip activity and predictability. Liner dips are a useful new technique that make the production of mixed containers and vigorous crops in baskets and other containers much easier and that allow for more efficient use of PGR chemicals. Consistent application procedures will be required to successfully adopt this technique. GPN

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