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Factors Affecting Activity of PGR Media Applications

With all the recent developments in the world of plant growth regulators, both in the products available and the methods to use them, it's important to understand the factors affecting each PGR, depending on how they're applied.

By Jim Barrett,
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The use of media applications of plant growth regulators for size control has greatly increased in the past few years. The traditional method for applying PGRs to the media is a drench to the media surface. The advantages are excellent size control, which is especially important for more vigorous varieties, and less effect on flowering compared to spray applications.

Recently, other techniques have emerged to take advantage of the benefits of media versus spray applications, including the use of lower concentrations earlier in the crop on poinsettias and others (Figure 1); application in sub-irrigation water; media sprays just before or soon after sowing seed in plug trays or transplanting plugs and liners to final container; treating seed prior to sowing; and liner dips (Figure 2). With the growing importance of media applications, we need to have a better understanding of all the factors that affect the activity of PGRs.

The chemicals with significant activity in the media (media-active PGRs) are paclobutrazol, uniconazole, ancymidol and flurprimidol. They

are nonionic and nonpolar molecules that have relatively low solubility in water. In the media, they do not behave and move like fertilizers. The media-active PGRs bind to organic components of media, but this is not an ionic binding as for fertilizers. The binding is with the wax layers on the surface of organic material.

The Role of Components

Figure 3 (page 40) shows how active paclobutrazol is in different media components. Media-active PGRs have less activity in pine bark media and this activity widely varies with the amount and type of pine bark in the media. Vermiculite has ionic sites and contributes to media's CEC, but it does not have wax layers to bind the media-active PGRs. So these chemicals are slightly more active in media with higher amounts of vermiculite.

In some of our recent work we are taking advantage of the fact that paclobutrazol does not bind to vermiculite. We are spraying the PGR on the vermiculite and then putting it in the media. This has potential to be an easy and effective way of applying a media-active PGR for early growth



Figure 1. These 'Wave Lavender' petunias in 10-inch baskets, photographed eight weeks after planting, are an example of how effective PGR drench applications can be. The basket on the left is the control, and the basket on the right received three drench applications of Topflor at 0.5 ppm. Topflor drench was applied in weeks 4, 5 and 6.



Figure 2. This is an example of a liner dip, a good method for applying PGR during planting of vigorous crops. The 4½-inch scaevola on the right was not treated. The liner (roots and media) of the plant on the left was dipped in 1-ppm paclobutrazol the day before planting.



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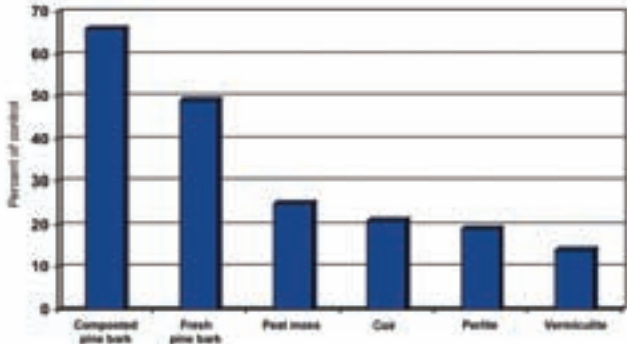


Figure 3. Paclobutrazol was applied to broccoli seedlings growing in substrate with different media components to determine the relative effect of the components on paclobutrazol activity. Broccoli is similar to seed begonia in its sensitivity to PGRs and is a good bioassay to determine amount of chemical in media or water.



Figure 4. The petunia 'Dreams Burgundy' on the left has not been treated with a PGR. The one on the right is growing in a media where vermiculite coated with paclobutrazol — equivalent to a 1-ppm drench — had been added to the media.

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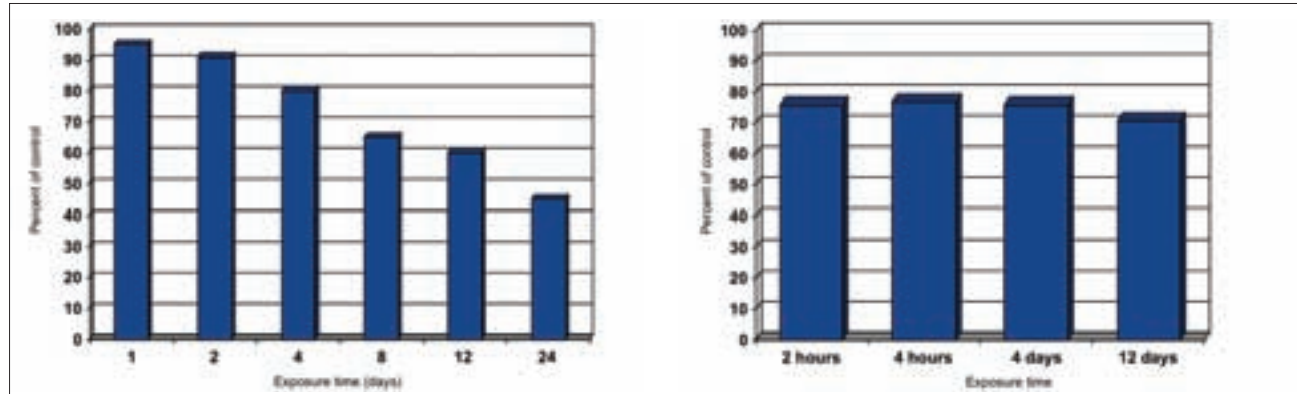
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Figures 5a and 5b. Researchers conducted a series of experiments to determine how quickly chrysanthemums take up a PGR after a drench is applied. They used a special split-root system so that plants were exposed to the PGR for only a given period of time. Figure 5a (left) is paclobutrazol. Plants were exposed to the PGR for one to 24 days, and the effect of the PGR on elongation was determined on day 24. Figure 5b is plants exposed to chlormequat (Cycocel) for two hours to 12 days, and effect was determined on day 12.

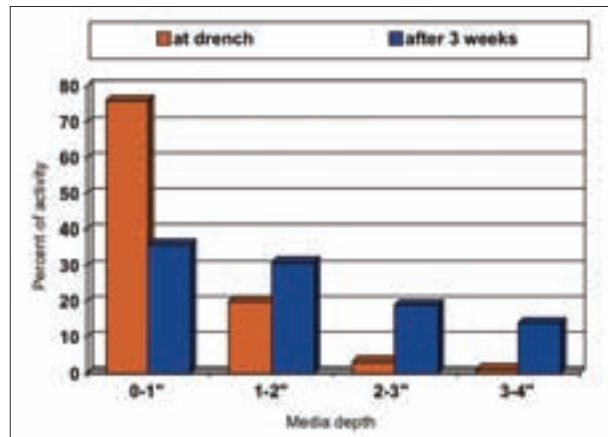


Figure 6. This figure shows the location of paclobutrazol in the media profile immediately after a drench, then after three weeks of overhead irrigation. Broccoli seedlings were used to determine amounts of chemical in the media in each layer.

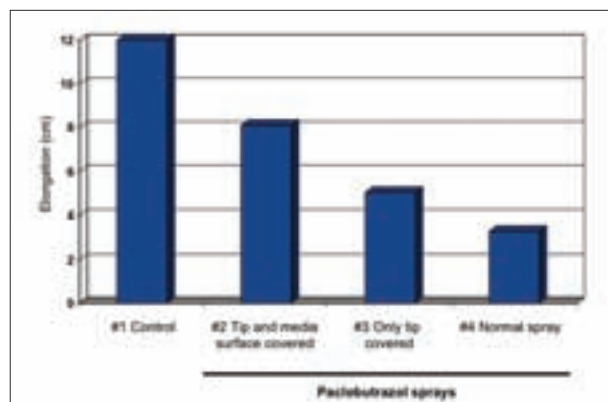


Figure 7. This graph demonstrates where a spray application of paclobutrazol is taken up in chrysanthemum. The first bar is the elongation of nonsprayed control plants; plants in the other bars were sprayed with paclobutrazol. The fourth bar is the elongation of plants with a normal spray. Shoot tips of the plants in the third bar were covered to prevent the spray from contacting that area. In the second bar's plant, shoot tips and media surface were covered to stop the spray solution from contacting the media.

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control as shown in Figure 4 (page 40). Note that currently this is not a labeled method of use for any of the PGRs.

Limited Exposure

We have looked at how quickly PGRs are taken up when applied as a drench (Figure 5, page 41). For

these studies, we used a special system that allowed the plant to be exposed to the PGR for durations of only a few hours or few days.

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Then we could see how the plants grew after the timed exposure to determine how much chemical was taken up during the exposure. We compared paclobutrazol, a media-active PGR, with chlormequat (Cycocel), a water-soluble, ionic molecule that does not bind to the peat moss. Chlormequat has some activity as a drench but is not nearly as active as the media-active PGRs.

In the paclobutrazol example, plants were exposed for one day and then measured 24 days later. There was only a 5 percent reduction in the height of those plants compared to untreated control plants. Heights of plants exposed for four and eight days were reduced by 20 and 35 percent, respectively, while plants exposed for the entire 24-day period were 55 percent shorter. This pattern shows that paclobutrazol is taken up slowly over time, and additional chemical is being taken up even three weeks after a drench application. When paclobutrazol is applied to the media, it quickly binds to the peat and other organic components and then is released back to the soil solution over time. Apparently relatively little is taken up directly from the solution when a drench is applied. We learned from these results that the activity of a paclobutrazol drench is not influenced by environmental conditions at the time the drench is made.

In contrast to the paclobutrazol uptake pattern, chlormequat exposure for two hours provided as much control as did 12 days of exposure. This molecule does not bind to the media and is taken up quickly from the soil solution.

Movement Through Media

The rapid binding of media-active PGRs affects how they move in the media (Figure 6, page 41). The drench was applied to a 6-inch azalea pot where to media depth was 4 inches. The media was then divided into four layers, each 1 inch thick. A broccoli bioassay was then used to determine the amount of paclobutrazol in each layer. When the drench is applied the paclobutrazol is quickly pulled out of the water and binds to the media in the upper layer. Over time, irrigation slowly moves the paclobutrazol down through the media. This distribution and movement is similar for all of

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the media-active PGRs. We have attempted to wash paclobutrazol out of a mix after a drench, but this quick binding prevents that. Also,

the quick binding in the upper layers means that increasing the volume of a drench does not move the chemical further down in the

media. When a media-active PGR is applied by subirrigation, the chemical binds to the media at the bottom of the container.

This binding and redistribution pattern can affect the activity of a PGR media application. We are currently investigating the interaction of where the PGR is applied, either going in through bottom of container or as a drench to the surface, and whether the irrigation is from above or by subirrigation. The most significant problem seems to be when an established plant is on subirrigation and the PGR is applied as a drench. In this case, there is probably less movement of the PGR near the bottom of the container.

Parts of Each Plant

The activity of a spray of one of the main PGRs also can involve movement into the media. Figure 7 (page 41) shows how important different portions of the plant are in the activity of a paclobutrazol spray. Plants in all but one bar in Figure 7 were sprayed with paclobutrazol. The fourth bar is the elongation of plants with a normal spray. Shoot tips of the plants in the third bar were covered to prevent the spray from contacting that area. In the second bar's plant, shoot tips and media surface were covered to stop the spray solution from contacting the media.

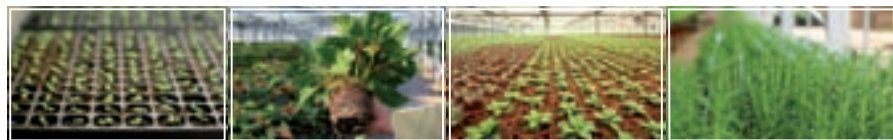
This research is giving us a better understanding of media PGR applications. The important factors that affect the activity of the chemical are 1) the rate in conjunction with growth rate of the crop, 2) the media components and how readily the chemical is released to the plant, and 3) how the chemical is applied and its relationship to irrigation methods. **GPN**

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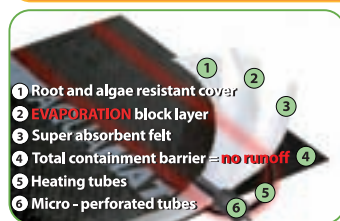
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