Learn how to incorporate plant growth regulators (PGRs) into your growing processes to obtain consistent results in an economical way.

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PGRs in Nursery Production

Plant growth regulators (PGRs) are compounds that we apply to improve the growth habit and reduce the size of commercially produced plants. PGRs that target the portion of the plant hormone system that produces gibberellins (plant hormones that increase cell elongation and, therefore, tissue elongation) provide many benefits to growers when they are properly and uniformly applied to the crop.

Growers using PGRs use less space per plant, thereby reducing their cost of production. They have less shrinkage or production losses because treated plants are more resistant to environmental stresses, like high or low temperatures or drought stress, than nontreated plants. This improved stress tolerance enhances plant shelf life — both in the production and retail settings. Using plant growth retardants to decrease plant height can allow a grower to meet shipping height requirements and ship more plants per truckload.

On the marketing side, plant height impacts perceived quality. A plant in balance with its container is perceived to be of higher quality than an "overgrown" plant. Therefore, using PGRs in herbaceous plant nurseries can improve plant quality and increase salability of the plants.

Learning to apply the correct PGRs at the correct time and in a consistent, uniform manner will provide the best results in the most economical manner.

Effective PGR treatments. You must know which PGR to use for a given crop and purpose. First, we have to know the objective of the treatment. This will dictate the type of PGR and the timing of the application. Know the target tissue or method of uptake of the PGR. Know how to determine the dosage required for the treatment. Recognize the environmental and cultural conditions of your operation that will affect your PGR application method or dosage. And, be sure to keep records of what you applied, when and how you applied it. Effective use of PGRs is still very much an art, but it is based on science. So, use your own notes on your applications and results to improve future success.

Timing of PGR applications. Most PGRs used in nurseries or greenhouses reduce plant growth rate so as to manage the final plant size. In general, we want shorter, stockier plants that are in balance with their container size. Treat early in the
plant growth cycle, prior to plant stretch. You cannot "shrink" the plant. The goal is to regulate growth over that period of rapid expansion to produce a stocky, shorter plant.

However, we also do not want to reduce flower number or size, or delay the flowering time. So, again, we need to apply PGRs early enough in the growth cycle to minimize flower effects. Recognize that flower effects in herbaceous perennials can be less predictable than with many of our annual floriculture crops. Preferably, treat before flower initiation because early applications minimize the effects on plant flowering.

Some of our PGRs are applied for other purposes. For example, BA (6-benzyladenine, Configure, Fine Americas Inc., Walnut Creek, CA) can be applied to improve the branching and pot fill of many herbaceous perennials. Its application requires that there be sufficient growth and branch initiation for effective response to the treatment. The treated plant also must have a well-established root system. Match your PGR and its application with the appropriate stage of plant development to obtain the desired results.

Know your PGRs. With respect to obtaining consistent application results, I like to categorize PGRs according to their ease of application. The first group contains PGRs that are not soil active. In other words, only the material applied to the plant is available to the plant. The overspray in the media is not absorbed by the roots of the plant. The primary PGRs in this category are daminozide (B-Nine WSG, OHP Inc., Mainland, PA; Dazide, Fine Americas) and Florel (ethephon, Monterey Lawn and Garden Products Inc., Fresno, CA).

Daminozide is a growth retardant with a short-term response, typically seven to 14 days. It is absorbed by the leaves, not translocated well inside the plant. Therefore, good coverage of the foliage is necessary for consistent growth responses in the plant, and multiple applications are likely to be required over a crop cycle.

Florel is a more special-use PGR. It is typically used to increase branching, especially in crops, like geranium, poinsettia and pansy. It has been used in propagation to remove flowers from stock plants and cuttings, which typically improves branching and enhances rooting. Again, obtaining consistent results requires good coverage of the foliage because Florel has no soil activity.

The second group contains those PGRs with limited soil activity. These PGRs may be absorbed from the media, but usually not in quantities great enough to complicate their application. Application is by foliar sprays, and good coverage is required.

The growth retardant in this category is chloromequat chloride (Cycocel, OHP; Citadel, Fine Americas; Chloromequat E-Pro, Etunga LLC, Cary, NC). We seldom see chloromequat chloride used alone in treating herbaceous perennials, but it is frequently used in a tank mix with daminozide. This combination of compounds provides a synergistic effect in reducing plant growth. In other words, we get more growth reduction with the tank mix than the additive effect of using these two PGRs separately. The tank mix typically provides longer-term control than daminozide alone. However, multiple treatments may still be required to control growth over the crop cycle.

Configure, the branching enhancer, has limited soil activity. Again, good coverage of actively growing plant material provides the best response. To be clear, none of these PGRs with no or limited soil activity is labeled for application through the irrigation system (chemigation).

The last category contains those PGRs that are soil active — they are readily absorbed by the root system from the media solution. These PGRs are absorbed by both the shoot (leaves and/or stems and petioles), as well as by root tissues. These PGRs are typically more potent than those that are absorbed by the foliage alone. The oldest labeled product in this group is anymycin (A-Best, SePRO Corp.; Abide, Fine Americas). Most recently la-
Rate of application is critical to success. Sumagic applied to Hibiscus moscheutos 'Carafe Grenache' as drench applications or a single foliar spray (left to right: untreated; drenches at 1/4, 1/2 or 1 part per million [ppm] applied at 10 ounces per trade gallon pot; and foliar spray at 20 ppm). The growth response to the drenches was saturated between the 1/4- and 1-ppm drench rates at six weeks after treatment.

Liner dips reduce REI (restricted entry interval) issues, provide uniform application and improve control of crops not responsive to spray applications. Concise liner dips controlled growth of Phlox paniculata 'David' at six weeks after treatment (left to right: untreated; 1, 2, 3, 4 or 5 parts per million).

beled for US ornamentals, but not new chemistry, is flurprimidol (TopFlor, Syngenta). The paclobutrazols were initially labeled for ornamentals in the late 1980s (Bontz, Syngenta Professional Products, Wilmington, DE; Piccolo, Fine Americas; Paczoil, OHP; Downsize, Greenleaf Chemical LLC, Henderson, NV). All of the above soil-active PGRs are currently labeled for chemigation.

The final group in this category—uniconazoles, generally the most potent growth retardant—is not labeled for chemigation. The uniconazoles include Sumagic (Valent U.S.A. Corp., Walnut Creek, CA) and Concise (Fine Americas). In addition to root uptake, the paclobutrazols and uniconazoles are primarily absorbed by stems and petioles. Therefore, foliar applications must penetrate the canopy to get good coverage of the stems and petioles.

Selecting the dosage. This is where the soil-activity category affects the ease of the PGR application. For PGRs with no or limited soil activity, the dosage is simply the concentration of the PGR in the solution (parts per million [ppm] or milligram per liter). With soil-active PGRs, the dosage depends on both the concentration of the PGR and the volume of the solution applied to the plant. Because the PGR in the solution—which runs off the plant into the media or hits the media directly—is also available to the plant, we have to consider both the concentration and the volume applied to determine the dosage.

For example, applying 50-ppm paclobutrazol at the label-recommended rate of 1 gallon per 200 square feet gave excellent growth control of hollyhock. However, applying 50-ppm paclobutrazol at twice the recommended volume (2 gallons per 200 square feet) resulted in an overdose response. Increased application volume of soil-active PGRs increases the plant response to the PGR application due to the additional PGR that is applied to and retained by the medium. The treated hollyhock plugs had good coverage with both volumes so the excess response was due to the additional PGR in the medium of the high-volume spray.

The dosage selected will also depend on the method of application. For example, foliar spray, drench or liner dip applications use very different volumes. Therefore, the solution concentration will vary as well.

Dosage of soil-active PGRs may change with the type of growing medium. When growing in very high bark medium, you should increase the rate of the PGR in the solution. Some applicators recommend up to 50 percent higher rates than those recommended for a peat-based medium. Some applicators say it makes little difference. This is one of the places where your notes of results in your own growing system are invaluable.

The stage of plant growth will also affect the volume of the solution that you use and therefore the concentration of the PGR to provide the desired dosage. For example, in well-developed shoot canopies, you will want to use a higher volume for foliar sprays of these PGRs, especially the paclobutrazols and uniconazoles, to get good penetration into the stems and petioles. Reduce the PGR concentration to accommodate that increased volume to avoid an overdose.

Finally, volume of application, especially with foliar sprays, can be an application tool. Recognizing the role that volume plays in the dosage applied, you can use one tank of PGR solution to treat plants requiring different dosages. For example, some growers treating multiple cultivars of pansy will apply one foliar spray at the label-recommended rate on all cultivars and then apply a second spray of the same solution on more vigorous cultivars. This effectively treats the vigorous cultivars with twice the dosage to give better growth control.

Cultural practices affecting PGR use. One of the most difficult areas of PGR use is determining the concentration or dosage of a given PGR to use on a crop. These rates vary in different parts of the country and with specific growing conditions. First, always ask where a recommendation originated. Rates used in the South (Georgia, Florida and many parts of Virginia) may be twice those used in the North (Michigan or New England). Adjust accordingly, and remember to test these rates under your own conditions.

The optimum rate depends on how you grow. For example, "dry" growers need less PGR than "wet" growers. Spacing affects PGR needs. High light is the best growth regulator we have. However, we typically cannot afford to grow plants at a spacing that eliminates plant competition. But, the tighter the spacing, the greater the PGR rate needed for control. Pruning or shearing practices also affect the need for PGRs. Heavy shearing of well-established plants will stimulate faster rank growth.
than pinching back of established or young plants and therefore will require higher PGR rates for control.

Growing temperatures will also affect the need for PGRs with lower rates needed under cooler conditions. Are you in a greenhouse where you have temperature control? Can you reduce your morning temperature to reduce growth? These treatments will significantly reduce the amount of PGRs you will use. Are your plants still in overwintering structures — too hot one day and too cold the next? Remember that PGRs affect plant growth. If it is too cold for plant growth, you will not see a response to the PGRs. If your plants are stretching in the cold frame — and you can get to them — go ahead and treat early.

Recordkeeping. As I mentioned earlier, PGR use is still an art. If you are not applying your own PGRs, train employees on the proper application techniques. Encourage them to develop the art of growth regulation. Be sure to keep a few untreated plants as controls so that you can see the effects of your treatment and judge the necessity of additional applications. Keep a record of the specific PGR rates and volumes used on the crop. Note the cultivars treated, growth stages and development of the crop. Note the weather conditions at the time of the application and beyond. And, don’t forget to record your assessment of the treatment and your own suggestions for improvement in future applications while they are fresh in your mind. The next year, these notes will assist you in planning your PGR program.

PGRs are production tools, just like fertilizer and water. So plan your PGR program just like your other production schedules. You may need to adjust to environment and cultural conditions. That is where you see the value of your notes.

If you are new to using PGRs, choose PGRs that are not soil active for ease of consistent application. The diminozide and chloromequat chloride tank mix can be very potent and is effective on a wide range of herbaceous perennials.

As you learn to use soil-active PGRs, consider the newer application methods, like media sprays or liner dips, that may reduce worker exposure and restricted entry interval issues. In addition, these application methods can increase the flexibility of your treatment and planting schedules.

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