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Cutting Edge PGRs

by Brian E. Whipker

Results of on going research projects conducted at NC State University are reported here.

This summary describes on going research being conducted at North Carolina State University. Our plant growth regulator focus involves extensive new formulation evaluations, exploring new PGR uses, determining suitable application methods, and optimal concentration studies. Below is a summary of some of our results.

1. PGR Residue

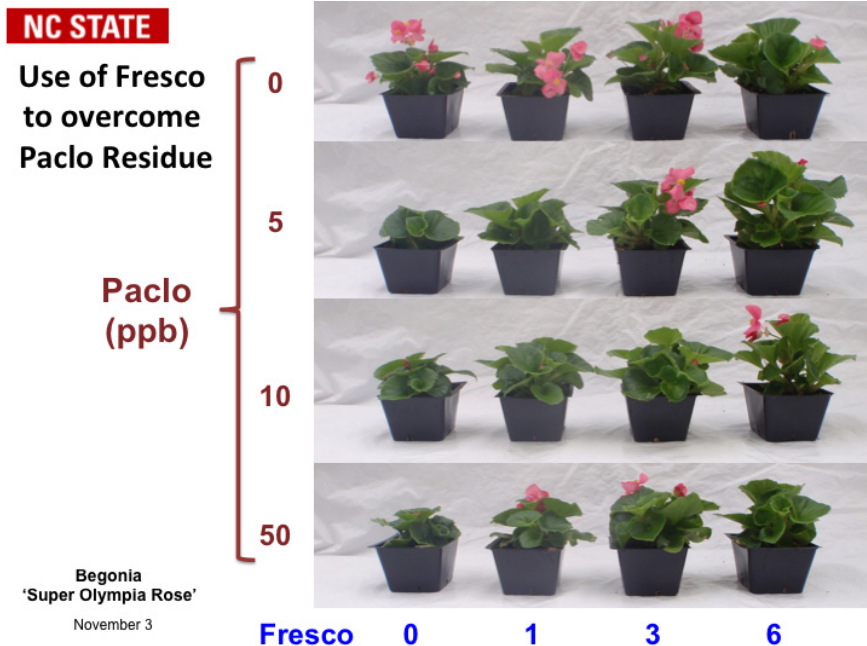
How Can PGR Residual in Irrigation Water Be Overcome?

Many growers who boom apply PGRs and recirculate their irrigation water have found it to contain up to 100 parts per billion (ppb) of paclobutrazol. This small level of paclo can effect growth of sensitive species such as was begonias, pansies and vinca. While there is a research group exploring ways to remove the paclo from the irrigation water, we wanted to find a short-term solution that growers could employ now.

Summary of Findings

- Fresco can be used to overcome residual paclo in recirculating irrigation water.
- Plastic pots need to be soaked in water at least 60 minutes to remove PGR residue.
- Preplant liner soaks can be used to control plant growth, but only possible when labeled.
- New web-based PGR rate app available.

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We conducted an experiment at NC State University in which plants were irrigated as needed with a 100 ppm N fertilizer solution that also contained 0, 5, 10 or 50 ppb paclo. To overcome the growth effects of the PGR, we applied Fresco foliar sprays at 0, 1, 3 or 6 ppm (sprayed twice). What we found was at low levels of paclo in the irrigation water (~5 ppb) that two spray application of Fresco at 1 ppm were sufficient. As the paclo residue in the irrigation water increased to 10 to 50 ppb range, the Fresco spray applications also needed to be increased, with 3 ppm applied twice being recommended.

The good news is Fresco is already registered for enhancing plant growth if a PGR dose has occurred. So if paclo residue is a problem, first determine the amount of residue in your irrigation water and then target foliar spray application rates between 1 and 3 ppm Fresco. Adjust rates as needed based on the plant's response. Read the Fresco label for additional use recommendations.

How Can PGRs Adhering to Plastic Containers Be Removed?

PGR residue had been reported to affect the growth of seedlings when plastic plug trays are reused. In an experiment at NC State, we wanted to determine how easily PGR residue of paclobutrazol (Bonzi) and flurprimidol (Topflor) could be removed by soaking the plastic in water.

We initially grew wax begonias in 1801s for one month. Then a second set of 1801s were soaked for 10 minutes in either paclobutrazol (Bonzi) at 0, 10, 20, or 40 ppm or flurprimidol (Topflor) at 0, 10, 20, or 40 ppm. These treated pots were allowed to dry overnight. The next day, the water soak treatments to remove the PGR residue were made, with a subset of each PGR Type x PGR Concentration pots being soaked in clear water for 0, 1, 10 or 60 minutes. The water was changed after each batch. Plants were randomly transplanted into the PGR Type x PGR Concentration x Soak Time containers and grown for an additional month.

We found that a sufficient amount of the PGR remained attached to the plastic if they were not rinse, with a greater amount of growth control occurring as the PGR concentration increased. For Bonzi, it appears to adhere more strongly to the plastic than Topflor. It is recommended that if growers are reusing plastic pots that they should be soaked for a minimum of 60 minutes in clear water. It is still a recommended best management practice to only use new plastic containers on sensitive species such as wax begonias, pansies or vinca.

2. Application Techniques

How Well Do Liner Soaks Work?

Only a few PGRs are labeled for a liner soak treatment, most notably some of the paclobutrazols. Researchers have also reported suitable concentrations for flurprimidol (Topflor) and uniconazole (Concise and Sumagic). So we wondered how well do some of the other PGRs would work as liner soaks?

Augeo. In one experiment conducted at North Carolina State University, we looked at preplant liner soaks of Augeo at 0, 400, 800, or 1600 ppm. This was a 2-minute soak of slightly dry liners (at the point of requiring irrigation). The plants were held for one hour and then transplanted into 5-inch pots. With 'Pretty Much Picasso' petunia, we found that soaks of 400 to 800 ppm were suitable for growth control. Concentrations of 400 ppm controlled growth of 'Sweet Caroline Light Green' ipomoea. With 'Lifetime Color Blaze' Coleus, soaks of 400 to 800 ppm enhanced branching, but did not control overall plant growth. For vinca, phytotoxicity occurred with >400 ppm and growth was not controlled. We observed no advantage of using preplant liner soaks of Augeo on seed impatiens or 'Snow Princess' lobularia (a near death experience). As with most PGR treatments, there are species in which the application provides advantages, while for other species it can be detrimental. Extensive trialing will have to be done to determine optimal rates before this option can be registered.

Ethephon. Florel has been used extensively as a foliar spray to increase branching and control growth. Recently substrate drenches were found to be effective too. So we were pondered if liner soaks would also work.

We used 'Kopper Kettle' coleus and provided a 2-minute

Petunia 'Pretty Much Picasso'

Augeo Liner Soaks (ppm)



Augeo \geq 400 ppm resulted in smaller plants

Dazide Liner Soaks



0 5,000 10,000 15,000 20,000

'Potunia Plus Pinkalious'

soak time for slightly dry liners (at the point of requiring irrigation). The concentrations used were 0, 125, 250, or 500 ppm Florel (ethephon). The plants were held for one hour and then transplanted into 5-inch pots. [Note: because of REI label recommendations, it is strongly suggested that the plants be treated and held for 48 hours in advance of transplanting.]

Ethephon at >125 ppm provided growth control. Recommended trial concentrations for liner soaks is between 125 to 250 ppm. As a general principle, soak concentrations of 25 to 50% of the spray rates should be tested with other species. Note this work reports on university trial results and at this time no ethephon product is currently labeled for liner soaks.

Daminozide. Daminozide is an excellent low impact PGR used on bedding plants. Daminozide is primarily taken up by the plant via the leaves when applied as a foliar spray. Daminozide is not registered for use as a substrate drench, because it is inactivated by the root medium. A conversation with a grower indicated that daminozide did have activity in hydroponic systems. This made us wonder, could daminozide be used as a preplant liner soak treatment where it has direct contact with the roots?

Dazide (daminozide) preplant liner soaks were made with 0, 5,000, 10,000, 15,000, or 20,000 ppm. We used 'Potunia Plus Pinkalious' petunias and a 2-minute soak time for slightly dry liners (at the point of requiring irrigation). The plants were held for one hour and then transplanted into 5-inch pots.

Dazide worked very well on the petunias, with 5,000 to 10,000 ppm providing ample control. Only slight

control occurred with marigold plugs at 10,000 ppm. So daminozide will provide growth control if root contact occurs. This application method may be suitable for northern growers who desire a limited amount of control, but the label does not allow for it at the current time. For Southern growers, it would be more economically feasible to use one of the registered paclo products.

How Well Do Ethephon Drenches Work?

Ethephon Drenches. Ethephon works well as a foliar spray. We also wanted to determine the optimal concentrations of ethephon to use as a drench. So we conducted a number of experiments to determine the suitability of ethephon (Collate) substrate drenches.

We found in most cases that between 125 and 250 ppm was the recommended concentration for petunias, geraniums and plumbago. Label usage is the next step in allowing growers to use this application method.

How Well Do Combination Sprays Work?

Two-way Combinations. At NC State, we conducted trials looking at the use of combination sprays of Collate + Configure and Collate + Piccolo 10XC. 'Defiance' and 'Oxford Street' coleus were used. A 3 x 3 factorial of Collate at 0, 250 or 500 ppm x Configure at 0, 100, or 200 ppm was used. The second set of treatments in a 3 x 3 factorial were Collate at 0, 250 or 500 ppm x Piccolo 10XC at 0, 10, or 20 ppm.

We found that the use of Collate foliar sprays by itself at 250 to 500 ppm provided suitable results. Neither the addition of Configure or Piccolo 10XC at the concentrations used provided any additional benefit.



Collate drenches (in ppm), photographs taken at bloom.



0 125 250 500

'Americana Dark Red'

Three-way Combinations. A number of growers are utilizing three-way combination sprays. The chemicals used are daminozide (Dazide) at 1250 ppm + ethephon (Collate) at 500 ppm + Configure at 100 ppm. This application is typically made during week 3 of propagation/rooting. At NC State, we conducted trials looking at the use of three-way combination sprays. We made an application during rooting at week 3 and after the cuttings had been transplanted (week 5).

We found that results varied significantly by plant type. In our trials we only used one cultivar per species, so results may vary by cultivar. For angelonia, coleus, coreopsis, and petunia, a week 3 application controlled growth and improved branching. For the cultivars used, the results were mixed for gomphrena, lantana, and New Guinea impatiens, portulaca, and scaevola. The treatment is not recommended for bacopa, calibrachoa, dahlia, portulaca, and scaevola. The main reasons for not using the treatment on the negatively affected species was root inhibition, leaf phytotoxicity, and stunted growth.

If applied 2 weeks after transplanting the plug (week 5), the results were suitable for calibrachoa and possibly angelonia. It was questionable for coleus, coreopsis, New Guinea impatiens and petunia. It is not recommended for bacopa, dahlia, gomphrena, lantana, portulaca, or scaevola (mainly leaf phytotoxicity, delayed flowering or stunted growth).

As with any PGR treatment, beneficial effects can occur with some species and cultivars, while other plants will be negatively affected. Therefore growers will have to conduct species x cultivar trials to determine if this application method is suitable.

3. Tips

Do PGRs Enhance Plant Color?

It is easy to see how the use of a PGR results in darker green leaves. The plants have an overall more healthy green appearance. This is because the use of a PGR helps increase the chlorophyll content of a leaf, which results in darker green coloration.

With some species, the use of a PGR can also enhance anthocyanin production. This can result in a darker red leaf coloration or a darker blue flower coloration.

Do PGRs Improve Water Use Efficiency?

When Bonzi (paclobutrazol) was first introduced, early research found that treated Colt Cherry rootstock plants used 55% less water than the untreated controls (Asamoah and Atkinson, 1985). At NC State University, we wanted to determine the effects on water use when optimal commercial PGR doses were applied (Ahmad, Whipker and Dole, 2015).

What we found with zinnia was water use decreased by ~33% with the use of optimal paclobutrazol (Piccolo 10XC) concentration. Water use and plant size correlated very well together. As a general rule, the decrease in water use was slightly greater than the degree of plant control. So if the plants are 30% smaller, the water use will be within the 30 to 35% range. So the use of a PGR to control growth also helps decrease the irrigation requirements of plants. This is intuitive, because have you ever noticed that untreated plants or the plants missed when the PGR was applied must be irrigated before the treated ones? With PGRs saving on water use, this makes it an excellent production tool and a required BMP.

What New PGR Information is available?

The 2015-2016 Plant Growth Regulators for Annuals is available for a download at the e-GRO website under the RESEARCH tab (<http://e-gro.org/research.php>). In addition, the 2014-2015 Plant Growth Regulators for Perennials by Joyce Latimer is also there. An updated perennial guide will be published in January 2016.

There is also a new e-GRO Rate App available for download (<http://www.egro.mobi/pgr.php>). This free web-based app provides recommended rate information.

PGR Mix Master is also available to help you calculate PGR mixing. It is a free app that can be downloaded for iPhone, Android and Blackberry (<http://extension.unh.edu/Greenhouse-Floriculture/Grower-Tools2>).

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Effect of 3-way foliar sprays on new growth

Petunia
'Sweetunia Hot Pink Touch'



Wk 3: provided growth control
Wk 5: excessive control, slight delay

NC STATE

Effect of 3-way foliar sprays on new growth

Scaevola
'Surdiva Blue'



Leaf phyto and stunted growth