

### PGRs: Control Your Quality

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Plant growth regulators (PGRs) are most commonly utilized by growers for controlling stem elongation, which results in shorter plants. However, PGRs are also used to encourage rooting, promote stem elongation, abort flower buds and for promoting branching. Many growers have improved the quality and performance of their liners by using plant growth regulators to promote or inhibit plant growth and developmental responses.

There's much information on using growth regulators for controlling plant height. This article addresses the use of PGRs for the promotion of root and lateral shoot development, the inhibition of flowering and their effects on shoot elongation. Our focus is how growers can utilize PGRs in liner production to build better starter plants.

#### Rooting

We often don't think of using growth regulators in the rooting process, but growers commonly use auxins to promote root development on cuttings and auxins are a type of PGR. While many plants don't require the use of a rooting hormone to uniformly and promptly root, other plants benefit greatly.



Figure 1. *Verbena Lanai Upright Bright Rose* with a 500 ppm Florel and 2,500 ppm B-Nine application.

Figure 2. *Pansy Cool Wave Yellow* with 500 ppm of Florel and 100 ppm of Configure 1 and 3 weeks after transplant.

Figure 3. *Potunia* with and without B-Nine and Florel overspray.

We compiled two tables (Table 1 and Table 2) showing our thinking on the benefit of using rooting hormones on various species of annuals and herbaceous perennials.

Species listed under the Low category are plants that root so readily that a rooting hormone isn't needed and/or provides little value. Plants listed under the Medium category will root without using rooting compounds, but will generally root faster or more uniformly if an auxin treatment is provided. Finally, annuals and perennials listed in the High category are species that are more difficult to root and there's higher value of using rooting hormones.

Rooting hormones are most commonly applied as a dip to the basal ends of the cuttings using either powder or liquid forms of auxins, such as IAA, IBA, KIBA or NAA, or as a foliar spray with the auxin generally being derived from KIBA. The basal dip application concentrations for annuals generally range between 1,000 and 1,500 ppm. Perennial rates are typically higher and range between 500 and 2,000 ppm. Spray application concentrations for both annuals and perennials typically range between 50 and 300 ppm.

The exact application rate for both basal dip and spray applications varies widely by plant species and its ability to root. While not common for annual cuttings, some perennial species, such as lithodora, root much better when they're dipped in a KIBA solution in the 1,000 to 2,000 ppm concentration range prior to sticking. Such cuttings should be rinsed just after sticking and prior to drying to avoid phytotoxicity.

#### Lateral shoot development

When transplanting liners, it's advantageous to utilize liners that are both compact and well branched. Growers obtain compact plants either by using PGRs, trimming the liners prior to transplanting or a combination.

Historically, ethephon under the trade name of Florel (also available as Collate and Verve) has been used to promote branching in various plants. Effective application rates for ethephon on the plants responsive to it typically range between 300 to 500 ppm. Research has shown that ethephon

by itself isn't always effective at promoting branching with many plant species.

In recent years, the cytokinin benzyladenine (Configure or RiteWay) has been shown to promote basal and lateral branches in a wide range of annuals and perennials. In fact, benzyladenine has become the industry standard for promoting branches on a wide range of perennial species. Effective application rates for benzyladenine on plants responsive to it ranges between 100 to 600 ppm.

In 2010, the tank mixture of ethephon and daminozide (B-Nine or Dazide) was applied to verbena by Maury Mairs and Patty Loosigian at Battlefield Farm in Virginia. The results of this application were amazing—the liners were well branched and compact without a mechanical pinch (Figure 1). Subsequent trial applications of 500 ppm ethephon in combination with 2,500 ppm daminozide gave positive and similar results on many other species.

Since then, it's become a standard practice by many growers to apply this tank mix to all liners once the plants have roots that have reached the edge of the media in the liner cell. Applications should NOT be made before the cuttings have rooted, as Florel has been shown to delay rooting. The application volume should be sufficient to wet the foliage completely without drenching the soil (typically 1.5 qts. per 100 sq. ft. is sufficient).

It's not clear why the tank mix of ethephon and daminozide is so much more effective in promoting branching than when either PGR is applied independently. After observing the response of numerous plants to the ethephon and daminozide tank mixture, the question has been asked if ethephon mixed with other growth regulators is synergistic. When ethephon is mixed with the cytokinin benzyladenine, a similar synergistic response has been observed (Figure 2).

### Flowering

Most growers propagate the majority of their annuals and perennials using unrooted cuttings (URCs). With many plant species, the URCs arrive in the vegetative form; however, there are some species that flower readily and the cuttings are often received with various stages of flower buds already present. For example, zonal geranium cuttings generally arrive with flower buds present on the URCs. Ethephon is effective at aborting flowers in geraniums, but applying ethephon to stock plants so vegetative cuttings could be shipped is problematic, as it results in residual ethylene release by the cuttings during shipment and subsequent leaf chlorosis.

Therefore, plant species where the cuttings arrive with flowers already present or that readily initiate flowers—such as zonal geraniums, double flowering impatiens and petunia—often benefit from ethephon applications during the liner phase. The tank mixture of ethephon and daminozide on these crops has been very advantageous at promoting branching, reducing plant height and also aborting the flowers (Figure 3).

### Shoot elongation to assist in pinching

Pinching of some species, such as osteospermum, is problematic, as the growing tip or meristem is located low in the leaves. Workers often miss a percentage of plants when pinching and mechanical mowing can result in excessive leaf removal.

One option is to promote shoot elongation to make the pinching process easier. Gibberellins are hormones that promote cell elongation and, therefore, shoot elongation. GA4+7 (Fascination or Fresco) can be applied to promote elongation about five days before the desired pinch date to assist with pinching. Rates used on annuals, such as osteospermum and poinsettia, typically are 5 to 10 ppm.

### Improving the success of PGRs during liner production

The majority of the research that we've participated in indicates that each plant species (and sometimes cultivars within the same species) responds differently to branching compounds and the rates that have been applied. Research results also indicate that multiple applications of lower rates usually provide slightly better results than when a single higher rate application is applied.

Greater results are also obtained when these products are applied to plants that are actively growing with roots at least visible on the outside of the root ball. Branching compounds should be applied using a sufficient application volume (usually 1.5 to 2.0 qts. per 100 sq. ft. of production space) and at a time of day where the spray solution can remain on the leaves for at least four hours. Always test small blocks of plants before making applications over an entire crop and apply PGRs according to the directions on each product's label. GT

Table 1  
**Annual Species**  
**Benefit of using rooting hormone in propagation**

Abutilon	Low
Alternanthera	Medium
Angelonia	Medium
Argyranthemum	Medium
Bacopa	Medium
Begonia - hiemalis	Medium
Begonia - Reiger	Medium
Begonia - Rex	Medium
Bidens	Medium
Bougainvillea	Medium
Brachycome	Medium
Bracteantha	High
Calibrachoa	High on certain cultivars
Calocephalus	Medium
Chamaesyce hypericifolia (Euphorbia)	Medium
Cleodendrom	Medium
Coleus	Low

Crossandra Medium  
 Cuphea Medium  
 Dahlia High  
 Diascia Low  
 Dipladenia Medium  
 Dracaena High  
 Fuchsia Medium  
 Gazania Medium  
 Geranium - Regal High  
 Geranium - Zonal Medium  
 Helichrysum Medium  
 Heliotropium Low  
 Impatiens - Double Low  
 Impatiens - New Guinea Low  
 Ipomoea Low  
 Lobularia Medium  
 Lophospermum Medium  
 Mandevilla High  
 Nemesis High  
 Osteospermum High  
 Oternaria Medium  
 Pedilanthus Medium  
 Perricalis High  
 Petchoa Low  
 Petunia Low  
 Phlox drummondii High  
 Plectranthus Low  
 Plumbago Medium  
 Poinsettia High  
 Portulaca Low  
 Pseuderanthemum Medium  
 Santolina Medium  
 Scaevola High  
 Scoparia Medium  
 Setcreasea Low  
 Torenia Medium  
 Verbena Low  
 Vinca (Catharanthus) Medium  
 Vinca major Medium

Table 2

### Perennial Species

#### Benefit of using rooting hormone in propagation

Achillea Low  
 Ajuga Low  
 Artemesia Medium  
 Artemesia - Silver Mound Low  
 Baptisia High  
 Buddleia Medium  
 Campanula Medium  
 Caryopteris Medium  
 Ceratostigma Medium  
 Coreopsis Medium  
 Delosperma Medium  
 Dianthus High  
 Erysimum Medium  
 Euonymus Medium  
 Eupatorium Medium  
 Euphorbia High  
 Gaillardia Low  
 Galium Low  
 Geranium Medium  
 Gypsophila High  
 Hedera Medium  
 Helenium Low  
 Heliopsis Medium  
 Heuchera High  
 Hibiscus Medium  
 Hydrangea High  
 Hypericum Medium  
 Iberis High

Lamium Low  
Lantana Bandana  
(maybe others) Medium  
Lavender Medium  
Leucanthemum Medium  
Lithodora diffusa High  
Lobelia Medium  
Lysimachia Low  
Malva Medium  
Monarda Low  
Nepeta Low  
Pachysandra Low  
Penstemon Medium  
Perovskia Low  
Phlox paniculata Medium  
Phlox subulata Medium  
Rosemary Medium  
Salvia Medium  
Scabiosa Medium  
Sedum Low  
Thymus Low  
Veronica Low  
Vinca Minor Medium  
Viola Medium

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