Step Up to the Plate

Grow a Better Liner
Meet Our Pros

This piece is all about how you can grow the BEST liner and hit a home run every time you stick a cutting.

Vegetative propagation is one of the most challenging phases of plant production — like trying to hit a great curveball — and takes a level of detail and consistent focus for any grower.

Our hope is that this supplement can help both large and small growers to propagate more effectively and better ensure the success of your vegetative crops.

We’ve divided this piece chronologically into the four phases or parts of propagation to help you to grow a better liner.

Spring Training

Planning, preparing and receiving your cuttings

Spring training of baseball for your cuttings. It’s all about shortening the time from the box to the bench.

Pre-Season

Media choice, tray manufacturing and proper fill

To ensure a good start for your cuttings, we highlight the important factors that should be considered before you stick.

Regular Season

Stages 1 & 2: From unrooted to rooted cuttings

In Stage one, we start with an unrooted cutting that has just been stuck and finish the stage with a callused cutting. Stage 2 starts with a callused cutting and ends with a rooted cutting.

World Series

Stages 3 & 4: Building, bulking, toning and pinching

Take your liner to the World Series. Stage 3 starts with a rooted cutting and ends once you have a transplantable liner. In Stage 4, we’re toning our liners to improve their success and uniformity after transplant.

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PLANNING
The goal of planning is to reduce the time from when you receive the cuttings to when they’re stuck—shorten the time from the box to the bench. In order to help this move as smoothly as possible, you need to plan ahead. What your plan should include:

- How many cuttings are coming each week?
- How many trays will you need?
- How much bench space will you need?
- How many employees do you have ready to work?
- What days will the shipments arrive?
- How much bench space will you need?
- How much training do you need to give your employees to properly handle the cuttings?
- How many trays will you need?
- How many employees are ready to work?
- What days will the shipments arrive?
- How many employees are ready to work?
- What are the temperatures for storing the cuttings?
- How much training do you need to give your employees to properly handle the cuttings?
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Uniform, high-quality liner production starts before the cuttings get into the propagation house, so be sure to put the proper emphasis on the manufacturing processes included when sticking your cuttings.

**TRAY QUALITY**

To ensure a good start to cuttings, we want to highlight the important factors to consider when you stick your unrooted cuttings. Things to consider: uniform soil levels in propagation trays, appropriate soil moisture at the time of stick, proper dibbling and utilizing rooting hormone.

There are many media options to choose from—paper pots, peat, peat perlite, foam plugs or stabilized media. Things to consider are: Will you fill your own trays or order pre-made trays? Do you prefer loose fill, media bound with paper or a stabilized media like Preforma? You should make your decision of what media to use by considering your operation and environment and the cost versus the benefit of each.

The quality of the liner depends on many different things. First, the media—be sure to check pH and EC weekly or biweekly. The pH should be between 5.5 and 6.0 and EC should be between 0.5 and 0.75. You want to ensure uniform filling of the trays and eliminate cells being filled at different levels. Be aware of soil compaction in your trays. If soil is too wet and compact, it can delay rooting time and quality. If you’re using media bound with paper, be sure that the paper isn’t higher than the plug or it will wick away the water.

**MOISTURE MANAGEMENT**

Soil moisture management starts before you stick your cuttings.

To ensure a good start for your unrooted cuttings, it’s important to consider the soil moisture both before and after the cuttings are stuck. This is important because improper soil moisture can quickly impact your cuttings in a negative way even before the cuttings are under mist. Soil that’s too dry will quickly pull away moisture from the cutting and result in unnecessary stress on the plant. On the other hand, soil that starts too wet will make it harder to achieve the ideal soil moisture level during callus formation and root initiation.

A lot of this depends on what trays you use for propagation and when they’re prepared. If you’re preparing trays in advance or purchasing pre-made trays, you’ll need to be sure that the soil moisture is correct before sticking your cuttings. If the soil has become too dry, it will be difficult to rewet and may take several irrigations and considerable time to get to the correct soil moisture. If this is the case, it’s important to start this process a day or more in advance of the cuttings arriving at your facility.

One of the first things you should do is determine what the proper moisture looks and feels like in your trays. At Ball, we work with a 1 to 5 moisture scale where 1 = bone dry and 5 = completely saturated. You may have developed your own scale already or you can use this one, but it’s important to have everyone involved in irrigating your crops speak the same language with regards to moisture management. Once your cuttings are stuck, it’s ideal to have the soil moisture at approximately a level 4. This would mean that water could be readily squeezed from the soil, but there’s not any freestanding water on the surface. A great way to put a value on the correct moisture is to weigh a few trays that you feel are at the ideal Level 4 moisture. The average of those measurements will give you and your team a target to hit and an expectation for what the right soil moisture looks and feels like.

**MOISTURE MANAGEMENT CHART**

<table>
<thead>
<tr>
<th>Soil Color</th>
<th>Level 5</th>
<th>Level 4</th>
<th>Level 3</th>
<th>Level 2</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Dark brown</td>
<td>Brown</td>
<td>Light brown</td>
<td>Tan</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moisture Content</th>
<th>Water freely drips from soil</th>
<th>Drips when squeezed</th>
<th>Single drip when squeezed</th>
<th>No dripping</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Soil Adhesion</th>
<th>Forms ball like tofu or pudding</th>
<th>Soil ball sticks together</th>
<th>Soil ball cracks apart</th>
<th>Soil ball crumbles</th>
<th>Soil ball won’t form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preformed</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**ROOTING HORMONE CHART**

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Source</th>
<th>Formulation</th>
<th>Ingredient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chrizopon</td>
<td>ACF Chemiefarmas</td>
<td>Powder (talc)</td>
<td>0.1% to 8% IBA</td>
</tr>
<tr>
<td>C-mone</td>
<td>Coor Farm Supply Services, Inc.</td>
<td>Liquid (isopropyl alcohol)</td>
<td>1% and 2% IBA</td>
</tr>
<tr>
<td>C-mone K</td>
<td>Coor Farm Supply Services, Inc.</td>
<td>Liquid (isopropyl alcohol)</td>
<td>1% KBA</td>
</tr>
<tr>
<td>C-mone K+</td>
<td>Coor Farm Supply Services, Inc.</td>
<td>Liquid (isopropyl alcohol)</td>
<td>1% KBA + 0.5% NAA</td>
</tr>
<tr>
<td>Dip’n Grow</td>
<td>Astoria-Pacific, Inc.</td>
<td>Liquid (alcohol)</td>
<td>1% IBA + 0.5% NAA + boron</td>
</tr>
<tr>
<td>Hormex</td>
<td>Brooker Chemical Corp.</td>
<td>Powder (talc)</td>
<td>Rooting Powder—0.1% to 4% IBA</td>
</tr>
<tr>
<td>Hormex</td>
<td>Brooker Chemical Corp.</td>
<td>Liquid</td>
<td>Hormex Concentrate—0.013% IBA + 0.24% NAA + vitamin B-1</td>
</tr>
<tr>
<td>Hydromin</td>
<td>E.C. Geiger, Inc.</td>
<td>Powder (talc)</td>
<td>0.1%, 0.3% and 0.8% IBA</td>
</tr>
<tr>
<td>Homoroot</td>
<td>Rockland Chemical Co.</td>
<td>Powder (talc)</td>
<td>0.1% to 4.5% IBA</td>
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<tr>
<td>IBA Water Soluble Salts</td>
<td>Hortus USA Corp., Inc.</td>
<td>Liquid</td>
<td>20% IBA</td>
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<tr>
<td>Rhizocon</td>
<td>Hortus USA Corp., Inc.</td>
<td>Powder and water-soluble tablet form</td>
<td>0.1%, 0.3% and 0.8% IBA</td>
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<tr>
<td>Stim-Root</td>
<td>Plant Products Co. Ltd.</td>
<td>Powder (talc)</td>
<td>0.1% and 0.4% IBA</td>
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<tr>
<td>Woods Rooting Compound</td>
<td>Earth Sciences Products Corp.</td>
<td>Liquid (ethanol)</td>
<td>1.03% IBA + 0.56% NAA</td>
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</tbody>
</table>

The soil level needs to be uniform in your propagation trays.

**Pre-Season**

Media choice, tray manufacturing and proper fill

The moisture level scale shown in this tray, with 5 being completely saturated on the left and 1 as extremely dry on the right.
ACHIEVING THE PERFECT Dibble

Proper dibbling is about more than just making a hole in the soil for the cutting to be stuck into. The dibble offers a target for your sticking crew, as well as a safe place for the cutting to go without risk of breaking the stem or damaging the base of the cutting. The location, depth and size of the dibble are all important details to discuss when training your sticking crew on proper dibbling. Location is pretty easy—the center of the cell.

Depth of the dibble depends not only on the size of cuttings being stuck, but it can also depend on what crop you’re sticking. Obviously, larger, longer cuttings will need a deeper dibble than smaller cuttings. In our experience, certain crops like calibrachoa and lobelia will root more quickly and uniformly when they have good contact between the base of the cutting and the soil. Dibble too deep and this contact won’t occur. I’ve seen many employees dribble through the bottom of the cell and leave the base of the cutting dangling in the air. Dibble too shallow and the cutting won’t go in far enough to be secure and the risk of breaking or damaging the cutting is greater.

And lastly, the size or diameter of the dibble is also important. A lobelia or calibrachoa cutting doesn’t need the same size dibble as a zonal geranium. You may need two different sized dibble pins for your sticking crew based on what they’re sticking.

ROOTING HORMONE

A great way to improve the uniformity and speed of root initiation in vegetative propagation is to use a rooting hormone (see page 7). Not all crops need hormone for fast rooting, but many will benefit from an application and the harder-to-root items and those crops that take longer to root are the best candidates for using hormones.

IBA is the most common and widely used rooting hormone for vegetative propagation and we’re sure many of you are familiar with some of these products. IBA can come in both a powder form, in a soluble salt form and a liquid form. IBA powder is available in several concentrations, usually between 0.1% to 0.3%, and is applied to the base of the stem prior to sticking.

The most popular soluble salt form is KIBA that can be applied to the base of the stem or as an overhead application as a coarse spray. When applied to the base of the stem, KIBA can be used in concentrations from 150 to 500 ppm. As an overhead application, KIBA rates are normally in the 50 to 250 ppm range. This method of applying your rooting hormone can be more cost effective and sanitary when compared to treating the base of the stem. Remember that the overhead applications need to be coarse enough to get the solution down the stem toward the base of the cutting. One warning regarding the overhead application: it will cause a leaf and/or stem curl in some crops, but they’ll normally grow out of this distortion within a few weeks. Because of this potential reaction, it’s always good to trial the overhead applications first before using as a broad treatment.

Liquid rooting hormone is also available and Dip N’ Grow is a widely used product that falls into this category. Same as the KIBA water-soluble salts, this product will be applied to the base of the stem prior to sticking the cuttings. As a best practice on sanitation, it’s best to apply this with a hand sprayer and avoid getting the solution on the leaves.

Rooting hormones are a great tool that every propagator should utilize to ensure a good start on harder-to-root crops.

Be sure to visit BallFloraPlant.com to reference GrowerFacts for more detailed information about which crops benefit from rooting hormones.

BIGGEST MISTAKES

- Not emphasizing correct tray manufacturing process
- Incorrect soil moisture at time of stick
- Improper dibbling (right depth and size)
- Not utilizing a rooting hormone

STAGE 1 OF PROPAGATION (FROM STUCK CUTTING TO CALLUS)

The first step is to decide if you’re going to use a surfactant. A surfactant works by breaking the surface tension on the leaf, which allows the cutting to hydrate quicker. This allows every mist cycle through the duration of Stage 1 to be more effective. Most importantly, surfactants help to minimize stress on the cutting.

Planning a proper mist strategy for the first stage of propagation is important to ensure success. After sticking the cutting, it can take anywhere from three to 10 days for the callus to develop depending on the crop. The goal is to rehydrate the cuttings as quickly as possible. Maintaining a high humidity during this stage helps the cuttings stay turgid. You don’t want cuttings to dry down or wilt during the first three to five days.

The ideal propagation zone should feel warm like a sauna. Soil temperature in the liners should be between 70 to 74°F (20 to 23.5C), depending on the crop and location. More importantly, the soil temperature should remain above 68°F (20°C) throughout the night. The daytime temperatures should range between 68 to 80°F (20 to 26.5C). You should increase humidity to maintain turgid cuttings, but not too high as to cause breakdown or botrytis. Light intensity should range between 1,300 to 1,500 foot-candles. Remember—minimizing the stress on the cutting and rehydrating are crucial in the first few days of propagation.

BIGGEST MISTAKES STAGE 1

- Allowing cuttings to dry down in the first three to five days
- Over-misting
- Allowing soil temperatures to drop below 68°F (20°C)
- Not having the right environment (too high of light levels, too much air movement)
- Not minimizing stress on the cuttings
STAGE 2 OF PROPAGATION (FROM CALLUS TO ROOTING)

Once the callus has started to form, we’re at Stage 2. For some crops, this can be just a few days after sticking, and for others, it could be six to eight days, so it’s important to understand when this occurs for the crops that you’re propagating because there’s action to be taken in this stage. In order to force the cutting to initiate roots, we must make it work a bit to survive, which means we start to cut back both the mist frequency and the soil moisture. So where does Stage 2 end? Once roots have emerged and are starting to grow, the soil moisture will be reduced and disease and insect pressure can increase quickly. Because we want to get them off mist as quickly as possible, this weaning process is crucial and propagators should know when to begin this process and have a strategy in place. You should always have an end date in mind for when Stage 2 will be complete and the mist will be off so that you’re working toward that throughout the Stage 2 timeline. If you feel that Stage 2 ends on day 12 after stick, then gradually reduce your misting/humidity each day until you get to the goal.

Some of the problems that are caused by over-misting or not weaning cuttings off mist in Stage 2:
- Increased instance of fungal diseases like botrytis
- Increased algae growth and more fungus gnat and shorefly pressure
- Reduced fertility in the cutting, as well as low EC in the propagation media
- Saturated soil that slows root initiation and rapid root growth, and decreases the uniformity of root initiation

MOISTURE MANAGEMENT

Saturated, or Level 5 soil moisture, will decrease the uniformity and speed of rooting for most crops, so it’s important to emphasize the proper soil moisture during Stage 2. Ideally you can maintain a Level 4 soil moisture during root initiation and then start drying down to a Level 3 as the roots start to elongate. Dry soil below a Level 3 during Stage 2 can stall the root initiation process, so too dry can be a problem as well.

FERTILITY

The cutting has been losing nutrients ever since it was severed from the stock plant and this is your first real chance to start to replace this lost nutrition. Ideally, you can provide some fertility in the mist during Stage 1 of propagation. The biggest benefit of this will come from the increased EC of the soil, as the mist water makes it to the propagation media. This is ideal because as the cutting strikes a root, we want to have some nutrients there for it to start taking up immediately. Regardless of whether you foliar fertilize or not, you should start fertilizing the soil in this stage to bring up the soil EC—75 to 100 ppm N of a balanced fertilizer like 17-3-17 is a great place to start. As your soil starts to dry down and the roots begin to elongate, you can recharge the soil EC at each irrigation, but be careful not to push too hard. This is a great environment to promote stretched internodes and rapid growth, so try to balance the fertility at this point until you can get your liners out of the house and into a better environment for toned growth.

**PGRS—CONTROLLED GROWTH MANAGEMENT**

This is likely the first stage in which a grower will start to treat liners with growth regulators. Not all crops will need treatments in this stage, but because of the need for controlled and compact growth, combined with an environment that provides conditions that aren’t favorable to this type of growth, we may need to begin PGR treatments. For vigorous and fast-rooting crops, we need to be prepared to tone the crop well before we’ve moved it out of the propagation zone or changed its environment. We often talk about stacking nodes on certain crops, especially those that we want to pinch, and this is the stage when those stems often stretch and they’re “unstacked.” Some crops will even stretch before they’ve started to root and could need a PGR treatment right at the beginning of Stage 2. Others could need it at the end of this stage and many won’t need any PGRs until the third stage of liners when lower activity like B-Nine (dibezinamide) and CycoFoil (chloromethquat) whenever possible. Because to know the vigor of the crops you’re producing so that you can stay ahead of the growth and maintain a toned liner coming out of Stage 2.

**PEST AND DISEASE CONTROL**

In Stage 2, the primary pest concerns will be fungus gnats and shoreflies. Sticky cards and population monitoring should be a big part of your weekly routine, and good algae control and sanitation will help with controlling populations as well. There are quite a few good biological options for controlling fungus gnats and several effective insect growth regulators that we can use to control the larvae in the soil. These options are best employed as preventative measures and should be used on a regular basis during propagation, but it’s usually best to use either biological or chemical control. You can use both in some instances, but if you’re using biological control, be sure to check on the toxicity of any chemical control that you may want to use.

Also important is to keep up with disease control in Stage 2, especially for botrytis. Even though we’re reducing humidity and slowly eliminating the mist, these cuttings are still in an environment that favors disease. This is why we must stay on top of preventative treatments to help eliminate shrink that can quickly occur in this stage. Utilizing a multi-site, broad-spectrum fungicide, like Daconil (chlorothalonil), as a preventative treatment is a good practice.

**BIGGEST MISTAKES STAGE TWO**

- Over-misting or not weaning cuttings off mist quickly enough
- Saturated soil moisture—this will lead to slow and uneven rooting in most crops
- Not reducing and eliminating night mist—most cuttings will be off night mist during this stage
- Not fertilizing in this stage
- Neglecting IPM and disease control
- Not using PGRS in this stage
1. Changing the environment
2. Building the root mass and bulking the top
3. Fertility
4. Pinching
5. PGs and controlled growth

CHANGING THE ENVIRONMENT—TO MOVE OR NOT TO MOVE

Once your cuttings have started pushing roots out and the mist is off, we can start to call them liners. Now that you’re liners, they no longer belong in your propagation environment. In order for you to give your liners the best conditions for quality growth, you must either move them out of your propagation house or leave them there and change the environment. Either way, a change in environment is the best management practice for this stage.

So what’s the ideal environment? We want to push moisture through the plant, but have temperatures that promote control growth while providing the highest light levels that the plant will accept. All of the factors that stimulate quality, controlled growth should be considered, including reduced humidity and temperatures, increased air movement and high light levels. These conditions aren’t always easy to create in the late winter months, but we must do the best we can with the resources that we have. Liners grown too dark, too warm, too humid, etc. won’t present you with the best opportunity for a strong, well-grown and finished crop. Conversely, liners grown too cold will likely not be ready for their target plant date. Balance the environment for the highest quality growth while keeping in mind your crop time. All of the other focal points of this stage will be directly linked to this topic and that makes it the single biggest key for successfully finishing a good liner.

BUILDING AND BULKING

In Stage 3, we must be sure that we’re getting our liners ready for transplanting into the finished container. This stage starts with a small plant that’s pushing out roots and ends with a transplantable liner that meets your specifications, so be sure to have a target or an expectation in mind as to what your finished liner will look like. In the building part of this phase, we like to focus on building the root mass so that we can have a strong start after transplanting.

As we all know, it’s important to have a well-defined root system so that the liners are easy for your transplant crew to handle and so that they quickly take off in their new soil. Soil moisture management is key in the building of root mass, so take great detail in maintaining good wet/dry cycles and avoid saturated soil for more than a day. Also, avoid hard dry-downs or wilting your liners, as this can damage and reduce root mass or slow take-off after transplant. The soil moisture management goal should be to stay in the “middle of the road” and ideally to alternate between Level 2 and Level 4 soil moisture. This environment will play a key role in your ability to achieve the ideal soil moisture and overall root mass developer for an “active” environment with lower humidity, higher light levels, increased air movement and appropriate temps for plant growth is the target.

The bulking part of this phase is about the green part of the liner. We need to bulk up our plant in order to meet our specifications in health and size as well as viruses. This is especially important for solanaceous crops like petunia and calibrachoa. The right mix of environment will play a key role, so be sure to match up temperatures that will keep the liner moving and developing, but won’t promote soft growth or poor quality. High light and cool temperatures have repeatedly been shown to produce the best plants, so when possible, match those two factors with the proper amount of plant growth to achieve our finished liner spec so we’ll produce the best product at this stage. The hardest part of providing the best environment is that not all plants have the same needs, so you’ll have to hit the middle of the road for what you’re producing and you may need separate zones for the warmest crops (think angelonia, lantana, sweet potato vine) and a different zone for the rest of your liners.

FERTILITY IN STAGE 3

This is the first opportunity to fully recharge our liners with the nutrients that they’ve lost since being removed from the stock plants. Again, the environment will play a key role, so we need to make sure our plants are “active” so that we can push nutrients into the soil and into our liners.

Stage 3 is often only two to three weeks long, so there isn’t much time to recharge our plants and, likely so is your fertility plan necessary. Choosing the best formulation of fertilizer is important in this stage, especially because of the high densities of the plants in your tray. A well-balanced fertilizer with calcium and magnesium, along with a higher percentage of nitrate to ammoniacal nitrogen, is best. This will help to promote controlled growth, but provide the plants with everything they need. In this instance, a 14-4-14 is superior to a 20:10:20.

Many growers will use a constant fertilizer strategy in this stage, but will keep their ppm N lower, like 7 to 150 ppm N, in an effort to better control the growth. Remember that most complete fertilizers will deliver 1 ppm Fe at a 200 ppm N rate, so if you’re doing lower ppm N than it’s advisable to increase your micronutrient package to deliver a 1 ppm Fe constantly to your liners. If you feel that your liners are behind schedule, don’t be afraid to push them with higher rates—they can take it. If you need to hold them, make sure to use clear water or reduce the ppm N. Remember the goal of producing controlled growth that meets your specs at time of transplant.

PINCING

Stage 3 is where most crops that need a pinch in the liner will get their pinch. As with all aspects of liner production, start this with the end in mind—in other words, what should the finished liner look like when it’s time to transplant? Do we want four, six or eight breaks on the liner? How many leaves or nodes should remain on the plant after pinching to achieve that? How tall should the plant be after pinching? How much space do we want between nodes or leaves when we pinch? These are all important questions to answer before you stick your cuttings and should be a part of your finished liner specifications. Once you know how many breaks you need and how developed you want the breaks at the time of transplant, you can plot a date on the pinch. This date will then become your target date for the plant to be ready for a pinch. You should have a size and number of leaves as part of the expectation or spec of your plant on this pinch date. Ideally, your pinched liner has breaks emerging and starting to develop, and unfolded leaves so that your finished liner is ready to quickly fill out the finished container after transplant. This means timing it correctly before the transplant date.

Sanitation is a big part of any pinching process and shouldn’t be taken lightly. Build this into your pinching process and be sure to communicate it properly to your crew; it should be a priority. Whether we pinch liners with scissors or shear them with a machine, there’s always the opportunity to rapidly transmit disease and we want to minimize this risk with the correct sanitation protocols. Pick a sanitizer that provides control of fungi and bacteria, as well as viruses. This is especially important for solanaceous crops like petunia and calibrachoa. Choose an appropriate concentration of sanitizer and be sure to review your sanitation protocols and implementation before use. Many growers will give their pinching crews two pairs of scissors and they’ll have one soaking in the sanitizer while using the other pair to trim a tray. Once the tray is finished, they’ll switch scissors. Don’t skip this step of the pinching process!

PGS AND CONTROLLED GROWTH

Stage 3 is the phase of liner production where time and controlled growth is most often lost, so having a plan or controlled growth strategy is important. Ideally, we can use environmental factors, moisture management and proper fertility to produce a toned liner that meets our specs, but sometimes that’s not enough. As all propagators know, growth regulators are one of the most useful tools in your tool box; however, over-regulation is one of the fastest ways to ruin a finished crop and should always be done carefully. As such, it’s important for you to formulate a controlled growth strategy. Know the genetic potential of the plants in your production plan so that you can formulate the best possible controlled growth strategy. For example, we regularly breed and select plants for specific uses like smaller pots sizes or alternatively, big vigor and fast growth for larger containers.
Having a PGR plan is important, including a list of regulators that you’re comfortable using on the crops that you’re propagating. When it comes to choosing chemistry to use, we recommend using regulators with lower activity whenever possible when finishing your liner. Growth regulators with lower activity like (B-Nine) daminozide, (Cycocel) chlormequat, (Florel) ethephon and (A-Rest) ancymidol are preferred options. Often times a tank mix of two like B-Nine/Cycocel or B-Nine/Florel are popular choices with propagators. Lower rates and more frequent applications are ideal to ensure that the risk of overregulation is minimal.

If you’re comfortable with more reactive or stronger growth regulators like Bonzi (paclobutrazol) or Sumagic (uniconazole), you can utilize them on your more vigorous genetics, but again, lower rates and more frequent applications are better. One thing to remember is that paclobutrazol and uniconazole can be taken up by roots, so unless you’re intentionally drenching them, it’s best to avoid soil contact. Always take a careful approach to PGRs in Stage 3, but they should be seen as a tool that’s often necessary to achieving the best finished liner.

STAGE 4: TONING YOUR LINER
This is the stage of liner production that’s most often overlooked, but it can be a very valuable part of growing the best liner possible. A toned liner will be better prepared for the stress of transplanting and the new environment that it’s often placed in once it’s in its new container. Providing a liner with higher light levels and cooler temps will increase your chances of success post-transplant. Soft or untoned plants will be slower to take off and may even be lost after undergoing the stress of transplanting. For small growers, there are other options, like using a hallway or outside hoops.

The toning process is driven by lower temperatures and higher light levels. Be sure to visit BallFloraPlant.com to reference GrowerFacts for more information.

BIGGEST MISTAKES
- Not changing the environment to promote controlled growth
- Insufficient moisture management that results in poor root system and soft growth
- Incorrect fertilizer choices—both formulation and rates
- No controlled growth strategy
- Overregulation with PGRs
- Pinching or shearing plants without a plan—plants are often too big at time of pinch or too small and cannot be pinched until after transplant
- Not toning your liners
Grab some Cracker Jack because we’ve got more information for you on growing a better liner. Kris and Jason show you all four parts of liner production in Ball FloraPlant’s video series—from planning and preparing to bulking and toning.

Go to http://ballfloraplant.com/BFPTV to get all of the play-by-play highlights.

You can also listen to Kris and Jason’s color commentary on liner production by viewing their two-part series of webinars at ballpublishing.com/webinars.