GROWERTALKS

Features

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Success By Design

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The secret strategy for quality vegetatively propagated spring crops isn't too complicated: healthy cuttings, healthy rooted liners, healthy finished crops. While much is written and discussed about managing fertilizer when finishing containerized spring crops, managing nutrients during cutting propagation receives less attention. But to produce healthy rooted cuttings, cutting fertilization needs to be managed across all five stages of liner production: Stage 0—Prior to harvest or arrival of cuttings; Stage 1—Cutting arrival and sticking; Stage 2—Callusing; Stage 3—Root development; and Stage 4—Toning.

These petunia cuttings have chlorotic lower leaves, a sign of nitrogen deficiency, and numerous breaks on cuttings with no strong meristem, a sign of an aborted shoot tip from calcium deficiency.

Managing macro- and micronutrients

In a nod to George Orwell's "Animal Farm," "All nutrients are equally essential, but some are more essential than others." There are certain nutrients to focus on providing cuttings (or not) and promoting their uptake and assimilation.

Starting with the primary macronutrients—nitrogen (N), phosphorous (P) and potassium (K)—what we provide and how much will vary throughout propagation. Nitrogen is required in the largest amount by plants. Not only does it promote green foliage, but it also can promote vegetative growth. While you need to provide sufficient nitrogen to keep both developing and mature foliage green, you don't want to provide so much that excessive growth occurs.

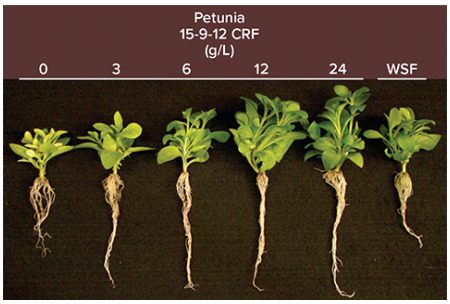
Start off by providing low concentrations of fertilizer during Stage 2—Callusing. As cuttings progress through Stage 3—Root development, fertilizer concentration should increase as root growth increases and shoot growth resumes. To help harden and suppress excessive growth, nitrogen concentrations can be reduced during Stage 4—Toning much like at the end of a finished, flowering containerized crop.

There's the idea that phosphorous promotes root development and, therefore, that increasing phosphorous concentrations can improve rooting. This is analogous to the idea that increasing phosphorus concentrations increases flowering when finishing flowering crops. The problem with increasing phosphorous concentrations is that it'll also increase stretch, which is almost always undesirable and something we actively suppress when growing containerized ornamentals. Selecting fertilizer formulations with low concentrations of phosphorous, like those formulated for seedling plug production, are great for minimizing phosphorous application during cutting fertilization.

The chlorotic new growth on these calibrachoa is a sure sign of micronutrient deficiency.

Out of the three secondary macronutrients—calcium (Ca), magnesium (Mg) and sulfur (S)—calcium can be the biggest concern during propagation. Calcium is involved in rapid cellular division and expansion, occurring both at the apical meristem of shoots, as well as in newly developing roots and primordia. A particular problem is when insufficient calcium is taken up by petunia or calibrachoa cuttings, the meristem ceases to develop and exhibits clubby-looking growth and axillary buds start developing into branches prematurely. While calcium deficiency can certainly be caused by insufficient calcium provided to plants, it can also result from insufficient uptake resulting from less-than-ideal greenhouse conditions (both of which will be discussed later).

Micronutrients including boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn) are no exception to what needs to be considered when fertilizing cuttings. In fact, many of the new vegetatively propagated species and cultivars being introduced to the marketplace have higher micronutrient requirements than seed-propagated crops. However, it can be challenging to provide sufficient micronutrients during propagation when lower nitrogen concentrations are being used.



Micronutrients are most commonly provided as part of a complete, balanced fertilizer formulation and are fixed in their proportion to nitrogen. When less nitrogen is provided, so are less micronutrients. This can be corrected by selecting a fertilizer with elevated micronutrient concentrations that will provide more micronutrients at lower nitrogen concentrations.

Controlled-release fertilizer can be used successfully to root cuttings in propagation, as seen with these petunia cuttings rooted with different concentrations of controlled-release fertilizer (CRF) or water-soluble fertilizer (WSF) four weeks after sticking cuttings and starting treatments.

For example, the "Peat Lite" formulations of 20-10-20 and 15-5-15 have twice the micronutrient concentration of the "regular" formulations and J.R. Peters Boosted Base fertilizer has around twice the micronutrient concentrations of "Peat Lite" formulations. These fertilizers with increased micronutrient concentrations aren't just great for finishing containerized annuals—they're great for fertilizing cuttings at low nitrogen concentrations, too.

Balancing moisture and mineral nutrients

One of the challenges with managing mineral nutrients and cuttings during the rooting process is how to deal with moisture—both in the substrate, as well as in the air. Once unrooted cuttings have been "stuck" into the substrate and moved into the greenhouse, producers strive to promote hydration and minimize wilt. There are two primary methods of keeping cuttings hydrated: 1) applying intermittent mist ("misting") to cuttings; and 2) keeping the

atmosphere humidified and at a high (>95%) humidity). Ideally, producers have misting and humidifying capacity and are able to pull the levers on both.

Mist is used to help maintain turgid cuttings, while also humidifying the environment. However, mist applications moisten the substrate and excessive misting and saturated substrates reduce the opportunity to provide water-soluble fertilizer (WSF) through irrigation. Saturated substrates can also reduce the active uptake of some nutrients like iron, with deficiencies developing with excessively wet root zones. Additionally, excessive leaching removes nutrients not only from the substrate, but from plant tissue as well. The best approach to misting is a balancing act: work to use as little mist as needed, while not stressing cuttings. But it isn't just excessive mist and saturated substrates we're worried about in propagation; it's the humidity or vapor pressure deficit (VPD) of the atmosphere, too.

Water moves from the plant towards a less-humid (or more-negative VPD) environment. As a result, when cuttings are initially stuck and placed in the greenhouse, high humidity or lower VPD reduces water loss and helps keep cuttings turgid and healthy. However, while this reduces water loss, it also reduces transpiration—the loss of water through stomata—and, therefore, water uptake. For nutrients like calcium and magnesium, this reduces their uptake and assimilation by the plant, since these nutrients are passively taken up along with water, unlike other nutrients which are taken up actively. While minimizing water loss is great—especially during Stage 1 and early Stage 2—transpiration and water uptake is also important for nutrient uptake, so the humidity should be reduced (or VPD increased) as propagation proceeds.

The same principle applies to humidity or VPD as it does with mist: work towards reducing the humidity and increasing the VPD as cuttings progress through Stage 1—Cutting arrival and sticking to Stage 4—Toning to promote water and nutrient uptake by cuttings.

Fertilizer forms and norms

Using WSF to fertilize liners provides the most flexibility for producers. Fertilizer can be applied through misting or irrigation at any time during propagation. Additionally, in many instances, the concentration can be changed, as can the stock solution (and, therefore, the fertilizer formulation) the injector is drawing from. There's no denying WSF are the most flexible tool for fertilizing cuttings.

However, although WSF are the norm, controlled-release fertilizer (CRF) is an effective form of fertilizer for propagating cuttings. By incorporating CRF into substrate prior to sticking cuttings, fertilizer will be provided to cuttings throughout the entirety of propagation.

There are a few considerations for using CRFs for liner propagation. First, use a CRF available as a micro prill. By using smaller-than-standard prills, the CRF will be more evenly distributed in the substrate and across the tray of cuttings. You can select different release rates, depending on your goal. A two- to three-month or three- to four-month release period is usually sufficient for liner production. Just keep in mind that to provide comparable amounts of fertilizer during propagation, you'll need to increase the amount of CRF used as the release rate increases to compensate for the slower release rate and decrease the amount of CRF used as the release rate increases to compensate for the faster release rate.

While the choice of fertilizer forms has been presented as an either/or proposition, using both is certainly an option—and a great one, at that. Much like for finishing annuals or garden mums, using a combination of WSF and CRF can be a great approach. By using a ¼ to ½ rate of CRF, combined with a similarly low concentration of WSF, you can reap the benefits of both fertilizers—the flexibility of WSF and the consistency of CRF—while minimizing

drawbacks by using complementary fertilizers.

Transplanting the takeaways

When healthy unrooted cuttings arrive, it's time to implement your nutrient management plan. Be prepared with the appropriate fertilizer formulations and injection equipment calibrated. Beginning in callusing, your fertilizer applications will maintain and enhance cutting health as roots and shoots develop, and how the greenhouse environment and irrigation practices are managed will interact with fertilizer applications and nutrient uptake. Working through the different stages of liner production, you don't want to just "set it and forget it" with cutting fertilization. **GT**

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