e-GRO Alert

W. Garrett Owen
owen.367@osu.edu

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Improving Rooting Uniformity with Rooting Hormones

Many growers propagate unrooted cuttings, but propagation success varies among species, cultivars, and environmental conditions. Rooting hormones can be used to ensure and improve rooting success of vegetative shoot-tip cuttings.

Many annual and herbaceous perennial bedding plants can successfully be propagated from unrooted shoot-tip cuttings (Fig. 1). Growers must maintain a favorable propagation environment and implement cultural practices to promote root initiation and subsequent root growth and development. While many growers may be challenged with achieving an optimal propagation daily light integral of 8 to 12 $mol \cdot m^{-2} \cdot s^{-1}$ or maintaining desirable air and root-zone temperatures or vapor pressure deficit, most all growers can easily implement rooting hormones.

Figure 1. A high-quality rooted herbaceous perennial cutting. Photo by: W. Garrett Owen.

Rooting hormones are considered plant growth regulating chemicals because they stimulate a favorable response in plants – rooting. When applied properly, rooting hormones can accelerate root initiation, improve rooting uniformity, aid in rooting of moderate to difficult-to-root species, increase the number of roots produced per cutting, and ultimately reduce

shrink and propagation time. Of course, when rooting hormones and other cultural practices are combined with optimal environmental conditions, results are high-quality, well rooted cuttings (liners).

Most often, rooting hormones are essential for rooting difficult-to-root annual and perennial bedding plants such as *Dahlia*, *Dianthus*, *Heuchera*, *Lithodora*, *Osteospermum*, and *Scaevola*. Rooting hormones can sometimes be used for species that may be somewhat difficult to root such as *Angelonia*, *Fuchsia*, *Lantana*, *Lavender*, *Leucanthemum*, and *Phlox*. Table 1 lists annual and perennial bedding plants that have a high, moderate, or low benefit (no hormone) to rooting hormone applications. Bedding plants listed as having a low benefit typically root without any hormone application; however, rooting hormone application can be beneficial by hastening root initiation and enhance rooting uniformity.

Many commercial root-promoting compounds are available in several forms and formulations, containing different active ingredients. Growers most often use rooting hormones that are in the form of talc powders, soluble tablets or powders, or liquids. These compounds contain auxins such as indole-3-butyric acid (IBA) or a combination of IBA and 1-naphthaleneacetic acid (NAA). Prior to handling any chemical, it is important to always read the label or MSDS sheet(s) for health hazards, personal protective equipment (PPE) requirements, and approved application method. In general, there are numerous methods in which rooting hormones may be applied before or after cutting stick including total immersion, basal quick-dips, basal long soak, stem base spray, and foliar sprays.

Figure 2. Basal or the cut end of the unrooted vegetative cuttings should be dipped into the talc powder-based rooting hormone. Photo by: W. Garrett Owen.

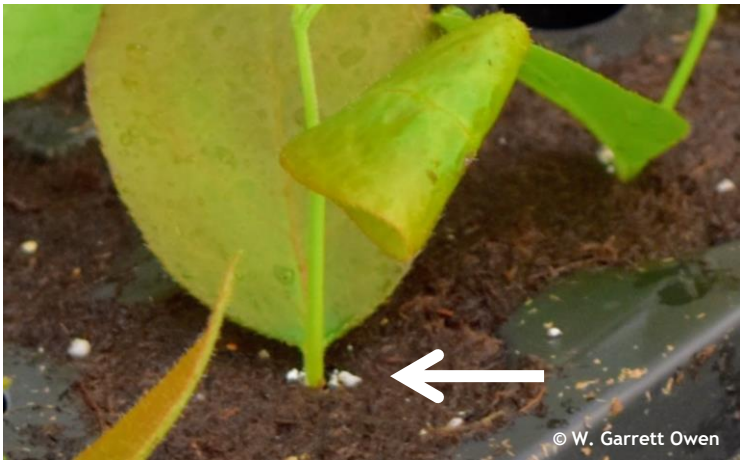

Figure 3. After dipping the cutting into the talc powder rooting hormone, growers should lightly tap the cutting to remove excess powder prior to insertion into the propagation substrate. Excess rooting hormone will fall off at cutting insertion. Photo by: W. Garrett Owen.

Figure 4. Empty containers used to hold talc powder rooting hormones for quick-dip application. These containers are to be sanitized before refilled with a new rooting compound. Photo by: W. Garrett Owen.

Table 1. List of annual and herbaceous perennial bedding plant species with high, moderate, and low beneficial response from a rooting hormone application in propagation.

High Benefit	Moderate Benefit			Low Benefit
Baptisia	*Alternanthera*	*Delosperma*	*Malva*	*Abutilon*
Bougainvilla	*Angelonia*	*Diascia*	*Nemesia*	*Achillea*
Brachycome	*Antirrhinum* [1]	*Dipladenia*	*Oternaria*	*Ajuga*
Bracteantha	*Argryanthemum*	*Erysimum*	*Pedilanthus*	*Artemesia*
Calibrachoa [5]	*Artemesia*	*Euonymus*	*Penstemon*	*Coleus*
Cineraria	*Bacopa*	*Eupatorium*	*Phlox paniculata*	*Diascia*
Crossandra	*Begonia, Hiemalis*	*Fuchsia*	*Phlox subulata*	*Gaillardia*
Dahlia, Annual	*Begonia, Reiger*	*Gazania*	*Plumbago*	*Galium*
Dianthus	*Begonia, Rex*	*Geranium*	*Poinsettia*	*Helenium*
Dracaena	*Bidens*	*Geranium, Zonal*	*Pseuderanthemum*	*Heliotropium*
Euphorbia	*Brachycome*	*Hedera*	*Rosemary*	*Impatiens, Double*
Geranium, Regal	*Buddleia*	*Helichrysum*	*Salvia, Annual*	*Impatiens, NG*
Gypsophila	*Calocephalus*	*Heliopsis*	*Salvia, Perennial*	*Ipomoea*
Heliotrope	*Campanula*	*Hibiscus*	*Santolina*	*Lamium*
Heuchera	*Caryopteris*	*Hypericum*	*Scabiosa*	*Lysimachia*
Hibiscus [6]	*Catharanthus* [2]	*Lantana* [4]	*Scaevola*	*Monarda*
Hydrangea	*Ceratostigma*	*Lavender*	*Strobilanthes*	*Nepeta*
Iberis	*Chamaesyce* [3]	*Leucanthemum*	*Torenia*	*Pachysandra*
Lithodora diffusa	*Clerodendrum*	*Lobelia*	*Vinca major*	*Perilla*
Lobelia	*Coreopsis, Perennial*	*Lobularia*	*Vinca minor*	*Perovskia*
Mandevilla	*Cuphea*	*Lophospermum*	*Viola*	*Petchoa*
Mimulus				*Petunia*
Osteospermum				*Plectranthus*
Phlox drummondii				*Portulaca*
Scaevola				*Sedum*
Thunbergia				*Setcreasea*
				Thymus
				Verbena
				Veronica

[1] Snapdragon
[2] Vinca
[3] *Euphorbia*
[4] Bandana; maybe others
[5] Cultivar dependent
[6] Tropical

Basal quick-dips and foliar sprays are by far the most common method of applying rooting hormones among most growers. For quick-dips, the basal (cut) end of each cutting is typically dipped individually into a talc powder or solution. This process is time consuming and labor intensive; however, I've seen growers bundle cutting of the same size and stem length to expedite the process. When using powder rooting hormones, one should dip the basal end of the cutting into the talc powder (Fig 2). The cutting should not be wet as moisture will cause the powder to clump. After dipping the cutting into the powder, lightly tap the cutting to remove excess powder prior to insertion into the propagation substrate (Fig. 3). In general, powder forms of rooting hormones are less effective than liquid rooting hormones applied at the same concentration. Furthermore, growers should renew talc powder rooting hormones daily (Fig. 4). Also, inspect expiration dates because formulations with low concentration of auxins remain effective for 1 to 2 years and higher concentrations ~5 years. Proper storage of the rooting hormone will also influence rooting results.

Procedures for applying liquid rooting hormones a basal quick-dip is like those mentioned for powders. In general, cuttings are dipped in a water- or alcohol-based solution containing 500 to 1,000 parts per million (ppm) IBA. Application rates are typically species-specific and sometimes, cultivar specific. When preparing liquid rooting hormones from a concentrate, it is recommended to read and follow the label rate for each species. To apply the solution, dip 0.25 to 0.75 inches of the cutting base into the solution for no more than 1 to 5 seconds. When applying quick-dips to cuttings, it is highly encouraged that applicators wear gloves. After dipping, it is important to keep the cutting vertical (cutting end down). This procedure avoids excess solution from dripping down the stem to the shoot-tip. Alcohol-based rooting hormone solutions can induce leaf twisting (epinasty) and stem curvature. While quick dips are easy and often result in uniform rooting, they can be labor intensive, dehydrate cuttings, and increase the risk of disease contamination. It is recommended to refresh rooting hormone solutions between species or batches of cuttings and daily.

Methods to improve production efficiency, address labor challenges, and improve uniformity while reducing shrink during cutting propagation has led many growers to adopt and implement rooting hormone foliar sprays. In the past, root-promoting compounds for foliar applications required growers to weigh and dissolve the product into water. Recently, Fine Americas, Inc. introduced Advocate®, a liquid 20% IBA compound which allows growers to easily dose the desired concentrate for mixing and application.

Foliar spray applications of rooting hormones are often applied within 24-hours after cuttings are stuck and placed in the propagation environment (Fig.5). Delaying spray application to the next day allows cuttings to rehydrate and mitigates the likelihood of cutting damage. Growers can apply foliar sprays early in the morning before misting begins or late evening afterward misting ceases. Applying under low stress conditions allows ample time for the chemical to dry. Temporarily stopping mist to apply the hormone can be performed, but growers should be careful not to withhold mist too long while the chemical dries as this may stress cuttings.

The concentration, volume, and uniformity of the foliar rooting hormone spray can influence success. In general, concentrations for annual bedding plants range from 100 to 400 ppm IBA. Concentrations up to 800 ppm IBA can be applied to herbaceous perennials (Fig. 6), but leaf twisting (Fig. 7), and stem curvature may be observed. Increasing IBA concentration applied as a foliar spray has shown to hasten root initiation in some perennial species by 7 to 14 days (Fig. 8). If a species is not labelled, conduct a small in-house trial starting with a low concentration of rooting hormone. Spray volume can influence the root-promoting effect. Growers should start at 2 quarts per 100 square feet and adjust by trialing volume rates. For more information about recent research on foliar spray applications of IBA, refer to:

- 2023-24 Plant Growth Regulator Guide for Annuals
- 2022-23 Plant Growth Regulator Guide for Containerized Perennial Plants
- e-GRO Alert 11-3: Hitting the IBA Sweet Spot to Improve Rooting
- e-GRO Alert 9-4: Tips for Rooting Difficult or Slow-to-Root Cuttings

For small to mid-size operations, foliar spray applications of rooting hormones can be applied with hand-held spray bottles or backpack sprayers. Larger operations may deploy booms. As mentioned before, it is important to always read the label or MSDS sheet(s) for health hazards and personal protective equipment (PPE) requirements. When mixing rooting hormone foliar sprays, it is recommended to wear protective eyewear, gloves, long sleeve shirts, and close-toed shoes.

Figure 5. Example of a foliar spray application of 1,000 ppm indole-3-butyric acid (IBA) being applied 24-hours after azalea (*Rhododendron simsii*) cuttings were stuck and placed in the propagation environment

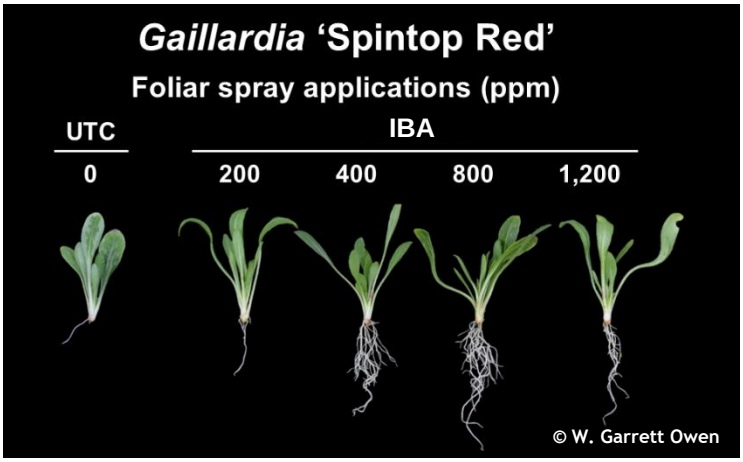

Figure 6. Foliar sprays containing increasing concentrations of 0 to 800 ppm indole-3-butyric acid (IBA) can be applied to herbaceous perennials without negative effects. Photos taken 28 days after foliar spray application at a rate of 0.5 gal/100 ft^2. Photo by: W. Garrett Owen.

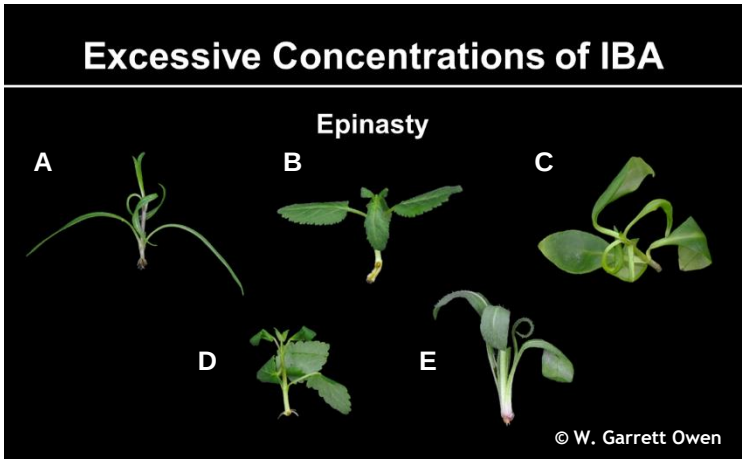

Figure 7. Epinasty or twisted growth of *Coreopsis* 'Lemocello Golden', *Veronica* 'First Love', *Phlox* 'Flame Pink', *Agastache* 'Blue Fortune', and *Gaillardia* 'Spintop Red' sprayed with 1,200 ppm indole-3-butyric acid (IBA). Photos taken 14 days after foliar spray application at a rate of 0.5 gal/100 ft^2. Photo by: W. Garrett Owen.

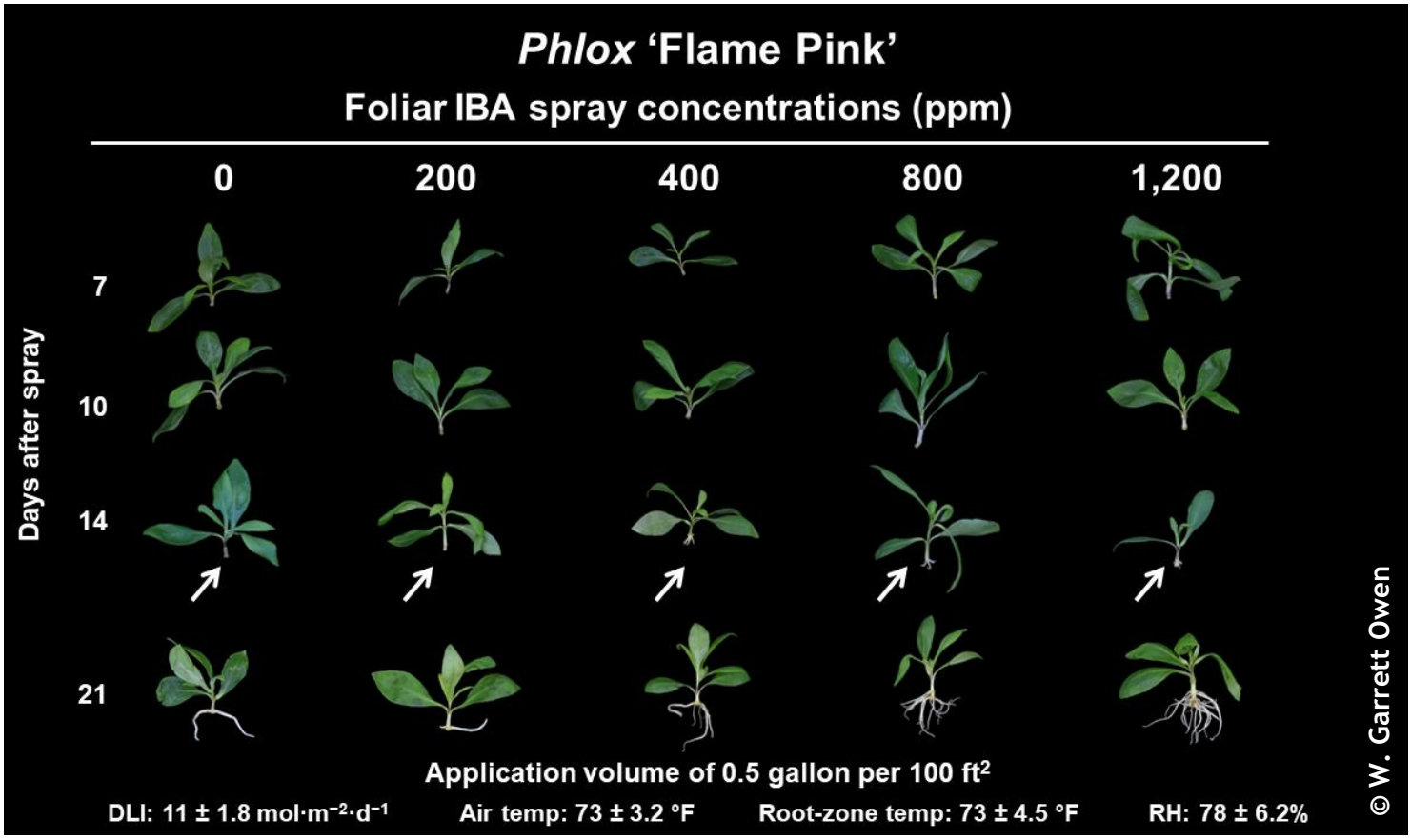

Figure 8. Increasing indole-3-butyric acid (IBA) concentration applied as a foliar spray has shown to hasten root initiation in some perennial species by 7 to 14 days. In this example, rooting occurred 7 days earlier when *Phlox paniculate* 'Flame Pink' (garden phlox) cuttings were sprayed with 200 to 1,200 ppm IBA compared to no IBA application (0 ppm IBA).

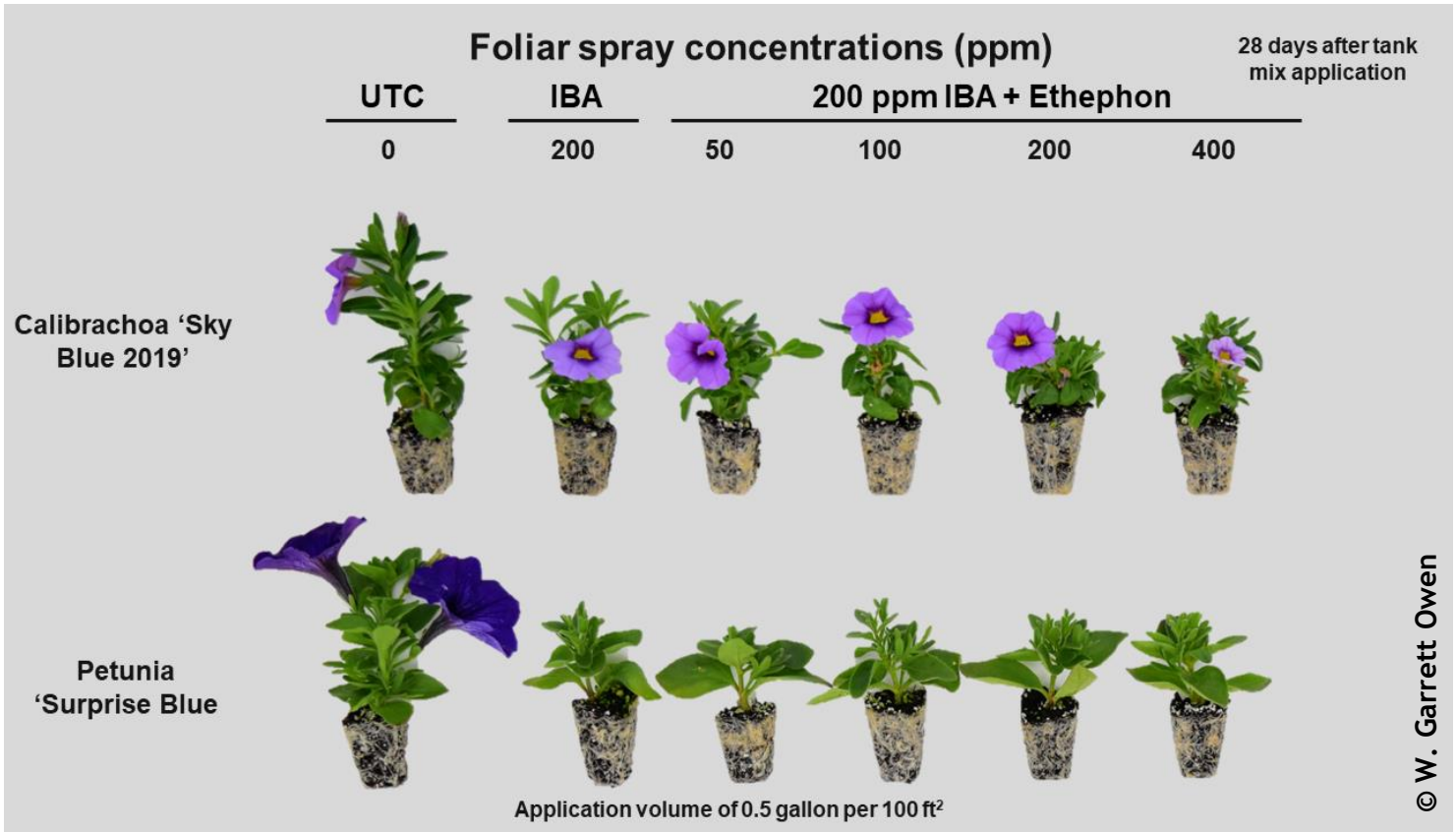

Figure 9. *Calibrachoa* Sky Blue 2019'(calibrachoa) and *Petunia* 'Surprise Blue' (petunia) cuttings at 28 days of propagation that received foliar spray applications of deionized water (0 ppm; control), 200 ppm indole-3-butyric acid (IBA), or 200 ppm IBA + 50, 100, 200, or 400 ppm ethephon at a rate of 0.5 gal/100 ft² with a handheld spray bottle from 6:00 to 7:00AM. Photo by: W. Garrett Owen.

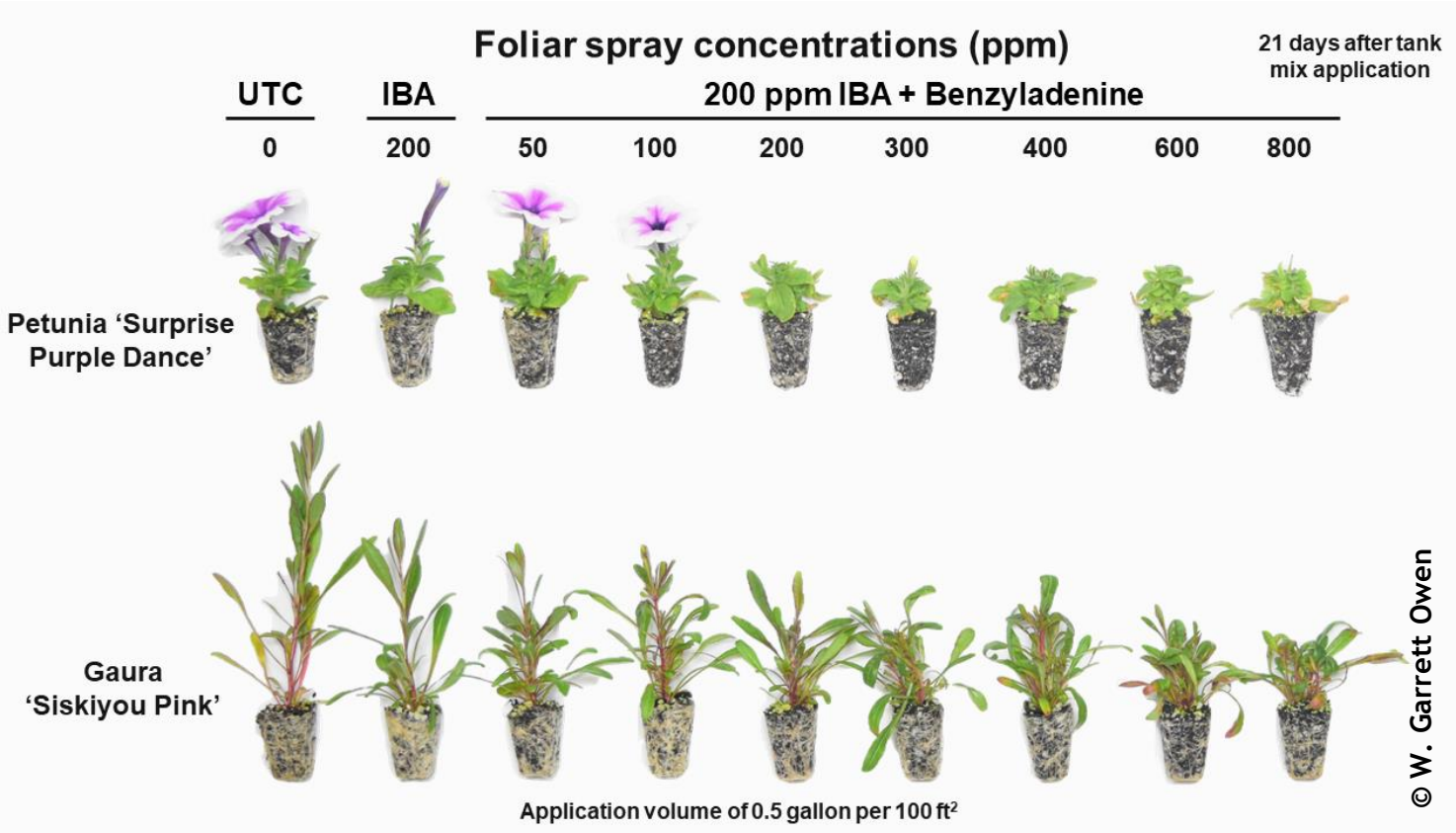

Figure 10. *Petunia* 'Surprise Purple Dance' (petunia) and *Gaura* 'Siskiyou Pink' (wandflower) cuttings at 21 days of propagation that received foliar spray applications of deionized water (0 ppm; control) or 200 ppm indole-3-butyric acid (IBA) + 0, 50, 100, 200, 300, 400, 600, or 800 ppm benzyladenine at a rate of 0.5 gal/100 ft^2 with a handheld spray bottle from 6:00 to 7:00AM. Photo by: W. Garrett Owen.

To further improve production efficiency, growers may also want to consider trialing tank-mixes of rooting hormones and plant growth regulators. Recently, researchers at The Ohio State University have investigated tank mixes of IBA and ethephon (Collate or Florel; Fig. 9) or benzyladenine (Configure; Fig. 10) to regulate growth and stimulate branching. These trials applied tank-mixes 10 days after the initial foliar application so prevent any root inhibition. Growers that are interested in tank-mixes should always read labels to determine regulations for tank mixing, perform chemical compatibility tests, and trial concentrations, volume, and application timing.

Overall, rooting hormones are a great addition to any propagator's toolkit to help with moderate to difficult-to-root crops or to hasten and improve rooting uniformity.

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CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tgf2@psu.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Chieri Kubota
Controlled Environments Agriculture
The Ohio State University
kubota.10@osu.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Sustainable Greenhouse & Nursery
Systems Extension & Research
The Ohio State University
owen.367@osu.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Alicia Rihn
Agricultural & Resource Economics
University of Tennessee-Knoxville
arihn@utk.edu

Dr. Debalina Saha
Horticulture Weed Science
Michigan State University
sahadeb2@msu.edu

Dr. Beth Scheckelhoff
Extension Educator - GreenhouseSystems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Ariana Torres-Bravo
Horticulture/ Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Ornamental Extension Plant Pathologist
University of Georgia
jwoodwar@uga.edu

Cooperating Universities

Cornell CALS College of Agriculture and Life Sciences

Cornell Cooperative Extension Suffolk County

PennState Extension

Iowa State University

UTIA Institute of Agriculture The University of Tennessee

UConn

College of Agricultural & Environmental Sciences University of Georgia

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