

# Stock Plant And Cutting Nutrition

We all know proper nutrition is needed when finishing crops, but this research shows just how important nutrition is for the cuttings taken from stock plants.

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**M**any production factors can affect cutting propagation of vegetative annuals: irrigation, light (photoperiod, irradiance and quality), plant growth regulators, temperature and mineral nutrition. Mineral nutrition has been investigated by propagators and researchers to improve cutting quality and yield, as well as root regeneration of cuttings. Research has also shown that adventitious root formation is affected by both initial nitrogen levels and carbohydrate status. For example, a high carbon-to-nitrogen ratio in tomato increased rooting of stem cuttings. However, rooting response has not been linked directly to individual carbohydrates, and other studies have shown that carbohydrates are not the primary reason cuttings root. Therefore, we will focus on the effects of mineral nutrition on cutting size (e.g., stem diameter, length and leaf area), yield and rooting response. In addition, we will provide the tools to manage the nutritional program.

This research project, initiated at North Carolina State University, Raleigh, N.C., focused on three vegetative annual species, scaevola 'Purple Fan', New Guinea impatiens 'Grenada' and vegetative bracteantha 'Florabella Pink'. The project had three main objectives:

- Determine the productivity of New Guinea impatiens and scaevola stock plants that were fertilized with increasing concentrations of nitrogen and potassium; evaluate cutting stem diameter, length and leaf area; and evaluate adventitious rooting of stem cuttings removed from the stock plants.
- Determine the impact of a light and a moderate deficiency of each of 11 essential mineral nutrients on rooting of stem cuttings of bracteantha.
- Determine the productivity of bracteantha stock plants fertilized with increasing concentrations of potassium, determine tissue potassium concentrations that produce high-quality cuttings, and evaluate adventitious rooting and length of cuttings removed from the stock plants.

## NPK Fertilization

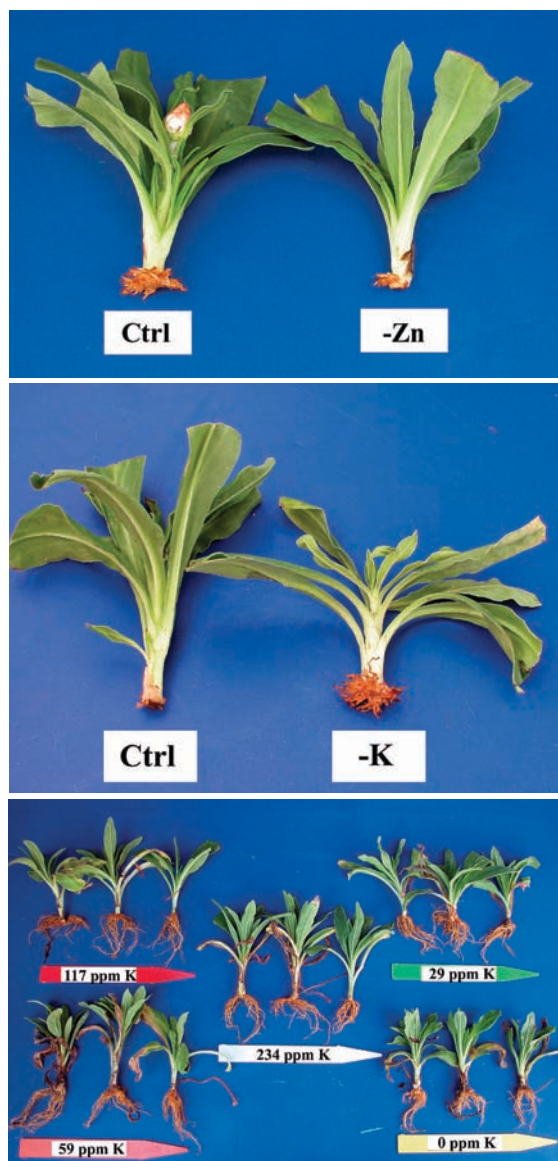
Nutrition not only affects cutting yield but also rooting of cuttings. Fertility studies on the rooting of chrysanthemum, poinsettia, coleus and dianthus cuttings under mist by researchers

at Cornell University, Ithaca, N.Y., demonstrated the importance of proper nutrition to stock plants. The total mineral nutrient content per cutting was the same before and after rooting; therefore, little or no leaching from these herbaceous species occurred. Leaching in herbaceous cuttings is typically minimal due to quick metabolization of nutrients within cells and cell walls.

For herbaceous cuttings to increase in dry weight, macronutrients are redistributed from mature parts of the cuttings to the new growth. Roots and leaves of chrysanthemum cuttings propagated under distilled-water mist developed and grew due to the redistribution of nitrogen, phosphorus and potassium. This research demonstrates the importance of adequately fertilizing stock plants. Providing a low-concentration fertilizer solution with low ammoniacal nitrogen and phosphorus after roots have formed is recommended for vegetative annuals.

Effects of nitrogen and potassium concentration on cutting yield, quality and adventitious rooting were measured at North Carolina State University to establish research-based stock plant fertility programs. Stock plants of New Guinea impatiens 'Grenada' (low fertilizer requirement) and scaevola 'Purple Fan' (moderate to heavy fertilizer requirement) were fertilized with all combinations of 100, 200 or 300 ppm nitrogen and potassium.

Results indicated the greatest yield of high-quality cuttings and optimum rooting with 300 ppm nitrogen. Fertilizing with potassium at 200-300 ppm did not improve New Guinea impatiens or scaevola cutting yield and rooting — with the one exception of greater shoot dry weight in scaevola with potassium at 300 ppm. However, an increase in shoot dry weight without a concomitant increase in root weight would be undesirable. A high root:shoot ratio is recommended for newly rooted cuttings because it avoids factors that reduce plug quality — stretched internodes, excessive soft foliage and a poorly developed root system. For this reason, potassium at 100 ppm appears optimal. Based on the research, the standard fertilization ratio of 1:1 nitrogen:potassium is not applicable to cutting production. Successful propagation of New Guinea impatiens and scaevola occurred at a 300:100 nitrogen:potassium ratio. ♦



*Top: Zinc-deficient cuttings had fewer roots than control cuttings. Middle: Potassium-deficient cuttings had more roots than control cuttings. Bottom: Impact on rooting of bracteantha 'Florabella Pink' under various potassium concentrations. (Photos courtesy of James Gibson)*



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### Nutrient Stress And Rooting

Little has been published on the effects of nutrient stresses on rooting of stem cuttings. When a nutrient stress occurs, a greater part of the residual nutrient is used by the root system for growth. Optimal rooting typically occurs when nitrogen is marginally low and carbohydrates are high in cuttings; high nitrogen tends to inhibit rooting. Stock plants fertilized with high rates of ammoniacal nitrogen will produce soft, lush cuttings that will not ship well. Because calcium and boron are essential for the development of new cell walls, it is critical that stock plants are not deficient in these nutrients. Zinc is required by the plant for formation of auxin, which stimulates adventitious root formation in cuttings.

Nutrient stress research on young plants improved visual appearance of bedding plant plugs at North Carolina State University. Low applications of phosphorus (restricting phosphorus to 15-20 percent of the nitrogen level) reduced plant height, improved tone and increased rooting. Propagators who reduce phosphorus may achieve shorter cuttings; however, too little phosphorus in the cutting may cause undesirable purple pigmentation and perhaps necrosis.

Research determined the impact of a light and moderate deficiency of each of the 11 essential mineral nutrients on rooting of stem cuttings of vegetative bracteantha. Visual symptoms of nutrient deficiencies in the chronological order in which they appear from initial to advanced stages were gener-

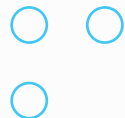
ated with an initial study. Stem cuttings were harvested when initial foliar symptoms were first expressed and later under moderate deficiency symptoms. Nutrients at an incipient or moderate stage of deficiency that reduced rooting were phosphorus, calcium and zinc. Interestingly, stem cuttings from potassium-deficient stock plants were shorter and had more roots than cuttings that received all essential nutrients.

### Growth Control

Vegetatively propagated bracteantha has introduced rooting challenges to propagators even after standard growing conditions have been provided. Inadequate fertilization of the stock plants has been suspected, and past research determined that low

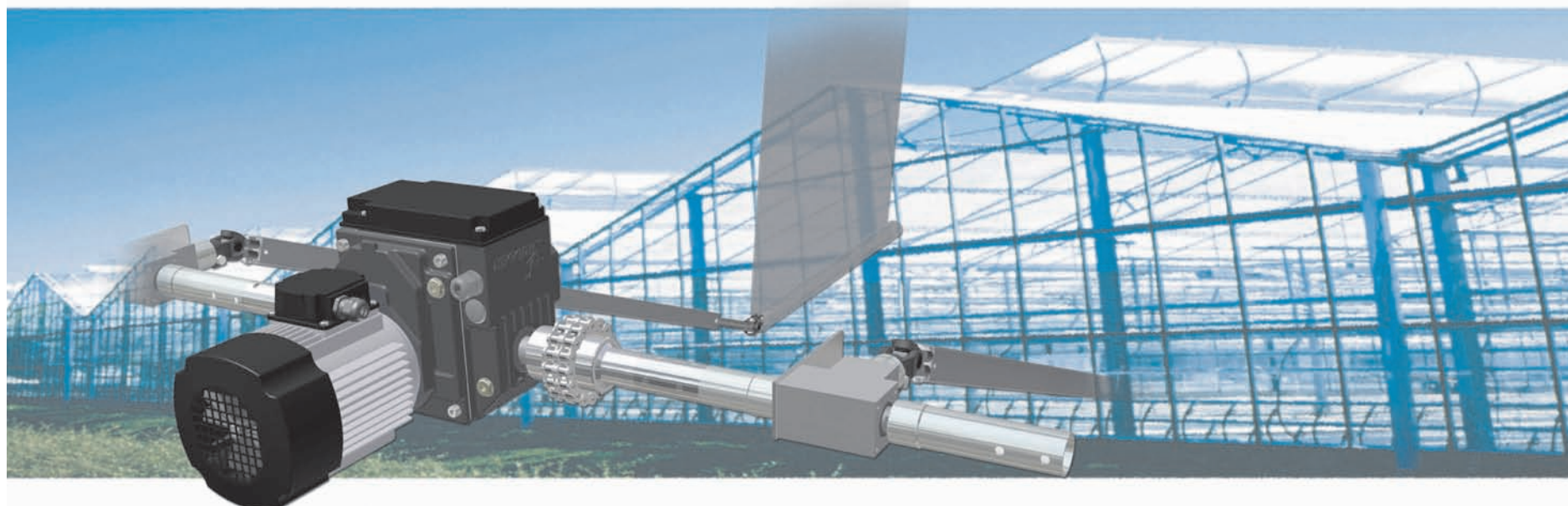


*Left: Influence on mimulus height with low potassium tissue concentration. Middle: Undesirable pigmentation and necrosis have occurred on petunia cuttings that have been restricted of phosphorus. Right: Phosphorus-deficient cuttings expressing darker, more slender leaves than control cuttings.*

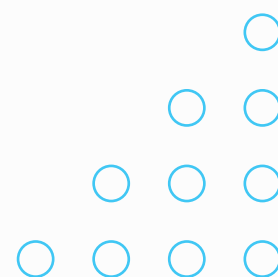


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### Tropical Plant Research

A limited amount of propagation research has been conducted on tropical plants. Growers have expressed a need for standardizing stock plant management protocols to maximize cutting yield and subsequent adventitious root formation. A number of issues have been voiced by growers wishing to propagate these plants successfully. Below is one of several stock plant management problems being addressed with support from the Fred C. Gloeckner Foundation.

**Problem.** Low stock plant yield and poor quality of bougainvillea cuttings.

**Objective.** To determine the nitrogen concentration that produces the greatest cutting yield and highest quality stem cuttings of bougainvillea 'Purple Small-Leaf' and 'Raspberry Ice'.

**Preliminary Results.** Based on analysis of the first harvest, bougainvillea 'Purple Small-Leaf' fertilized at 100 ppm nitrogen produced fewer cuttings than plants fertilized with nitrogen at 200 or 300 ppm. There were no differences in yield when stock plants of 'Raspberry Ice' were fertilized with nitrogen at 100-300 ppm.



Top: Stock plant of bougainvillea 'Purple Small-Leaf'. Bottom: Stock plant of bougainvillea 'Raspberry Ice'.

cutting tissue concentrations of calcium, phosphorus and zinc negatively affect rooting performance. However, potassium was shown to improve rooting with lower concentrations in the cutting tissue.

Little research has been conducted on restricting potassium concentration for floriculture crops to maintain compact cutting shoots and increase rooting. Plants in an active growth phase have a higher potassium requirement. Because stock plants are continually producing new shoots, low potassium fertilization may be detrimental to cutting yield, quality and rooting performance. Low potassium fertilization programs are not used commonly because most floriculture crops perform best at a 1:1 nitrogen:potassium ratio. The exceptions are dianthus and cyclamen, which require 1:1.5 and 1:2 nitrogen:potassium ratios, respectively, during their active growth phases. Fertilizing stock plants at lower con-

centrations of potassium can be problematic. For example, potassium deficiency can reduce transpiration, which ultimately affects nutrient translocation and photosynthesis.

Research was required to determine the threshold concentration of potassium, where cutting yield and quality were not reduced and rooting was improved. Therefore, the objectives of this research were to determine the relationship between cutting yield of bracteantha stock plants and potassium fertilization, to determine stock plant tissue potassium concentrations associated with quality cuttings and to evaluate adventitious rooting and height of cuttings removed from the stock plants.

Yield and subsequent rooting of stem cuttings of bracteantha stock plants were recorded when fertilized with potassium at 0, 29, 59, 117 or 234 ppm. Cutting height was also evaluated because previous research had shown that lower concentrations of

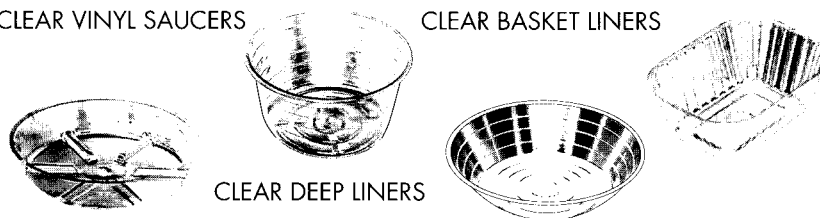


A high root:shoot ratio is recommended for newly rooted cuttings because it avoids stretched internodes and excessive soft foliage.

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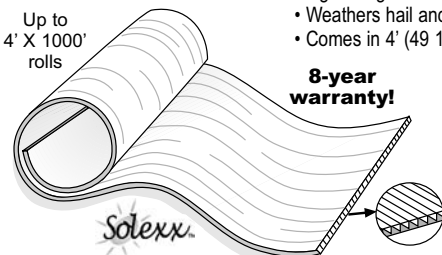


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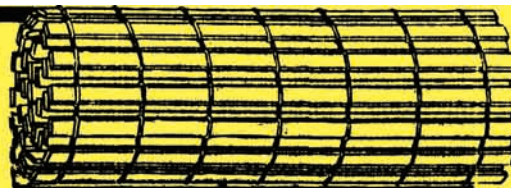
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potassium produced compact shoots with commercially acceptable roots. While a threshold level of potassium at 32 ppm achieved the highest number of cuttings, rooting was not different with cuttings from stock plants fertilized with potassium at 59-234 ppm. Deficiency symptoms appeared on stock plants fertilized with potassium at 59 ppm and less with necrosis on mature leaf tips and interveinal chlorosis on recently mature leaves. The minimum stock plant's recently mature leaf potassium concentration necessary to avert unacceptable deficiency symptoms during subsequent rooting of cuttings was found to be between 4.7 and 6.6 percent potassium. Stock plants of bracteantha can be fertilized at 1:1.1 nitrogen:potassium ratios (nitrogen at 217 ppm and potassium at 234 ppm) or 2:1 (nitrogen at 217 ppm and potassium at 117 ppm) because upper cutting foliage did not exhibit deficiency symptoms, and optimal cutting yield and rooting occurred.

### A Nutritional Program

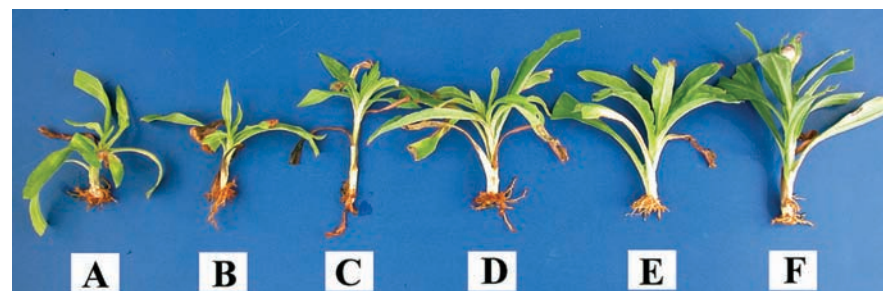
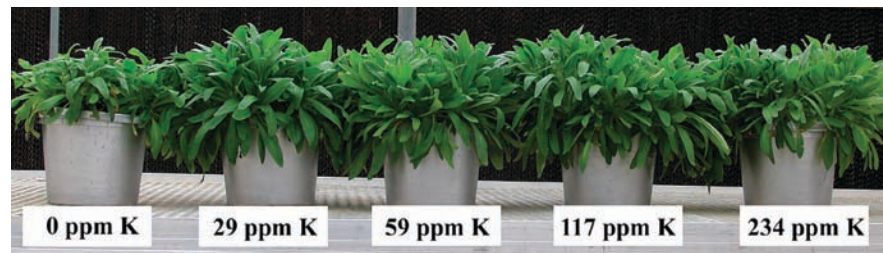
Fertilizing through overhead mist emitters is normally not recommended for vegetative annuals unless cuttings are on the propagation bench for an extended period of time, typically longer than four weeks. Fertilizers may clog mist emitters if salts precipitate in the water line. Therefore, cuttings of vegetative annuals should be fertigated through a hose. In general, the first application of a soluble fertilizer can occur at signs of a visible callus, using rates of nitrogen ranging from 50 to 75 ppm. Normally this occurs around 5-10 days after sticking cuttings. Once the root initials protrude from the cutting base, cuttings can be lightly fertilized with 100 ppm



Impact of nitrogen and potassium concentration of rooting performance of scaevola 'Purple Fan'.

nitrogen from a complete fertilizer. Cuttings should never be fertilized when the media is dry.

A low phosphorus and ammonium-nitrogen fertilizer should be used during propagation. High levels of phosphorus have been shown to increase stem elongation, promote flowering and be toxic to some of the native Australian species such as scaevola and argyranthemum, while ammonium-nitrogen causes lush cutting growth. Propagators should use fertilizers such as 13-2-13 and 15-5-15 in the propagation area weekly at concentrations of 50-100 ppm nitrogen. Acidic fertilizers such as 20-10-20 should be used if growers have moderate levels of alkalinity in their irrigation water. To moderate the high phosphorus and ammonium-nitrogen of the commonly used 20-10-20, a low rate can be applied to provide micronutrients, and growers can rotate the



Top: Influence of potassium concentration on stock plant canopy of bracteantha 'Florabella Pink'. Bottom: Control cuttings of vegetative bracteantha after A) 36, B) 33, C) 30, D) 27, E) 24 and F) 21 days after sticking in a nutrient-free environment. Notice the lower leaf chlorosis (nitrogen deficiency) after 21 days in propagation.



## Want More?

Visit the following Web sites for more photos to help you identify nutrient deficiencies and toxicities:

### University of Florida


[http://wfrec.ifas.ufl.edu/faculty/gibson/nutrient\\_deficiencies.htm](http://wfrec.ifas.ufl.edu/faculty/gibson/nutrient_deficiencies.htm)

### North Carolina State University

[www.ces.ncsu.edu/depts/hort/floriculture/def](http://www.ces.ncsu.edu/depts/hort/floriculture/def)

feedings with a dark-weather formula or calcium nitrate.

## Using The Results

Propagators should adopt a nutrient program that produces the maximum quantity of stem cuttings with the highest quality. Propagators should consider other external factors such as humidity, irradiance and temperature before establishing a fertilization program. Propagation of vegetative annuals has become a means of producing plants that have historically been grown from seed — crops such as coleus, impatiens, bracteantha and verbena. Our knowledge about how to propagate these floral crops has been gleaned from what we know about plants traditionally propagated from cuttings such as chrysanthemums, geraniums, poinsettias and New Guinea impatiens. Unfortunately, mineral nutrition of stock plants and cuttings is based rather on practical knowledge, with reference to cultivation of flowering plants. Maximizing productivity of stock plants in the propagation industry may reflect the opposite of what is to be considered common growing strategies for the finished product. 

*James Gibson is assistant professor and Christopher Cervený is a graduate research assistant in Floriculture at University of Florida-Milton; Brian Whipker is associate professor, Paul Nelson is professor and John Dole is professor in the Department of Horticultural Science at North Carolina State University, Raleigh, N.C. Gibson can be reached by phone at (850) 983-5216 or E-mail at [jl Gibson@ifas.ufl.edu](mailto:jl Gibson@ifas.ufl.edu).*

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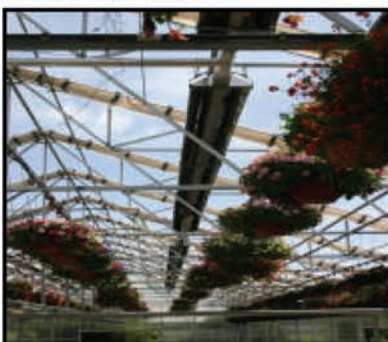
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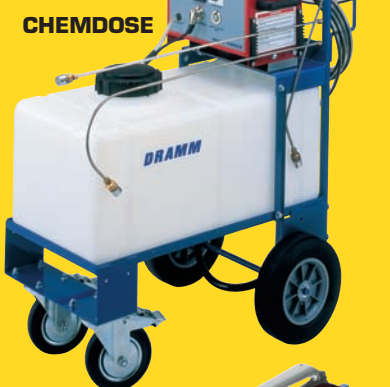


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