GROWERTALKS

Features

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Finding the Sweet Spot

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Figure 1. Expected vs. measured EC comparison, pH readings and demonstrated geranium growth curve from low (37.5 ppm N) to high (600 ppm N) fertility.

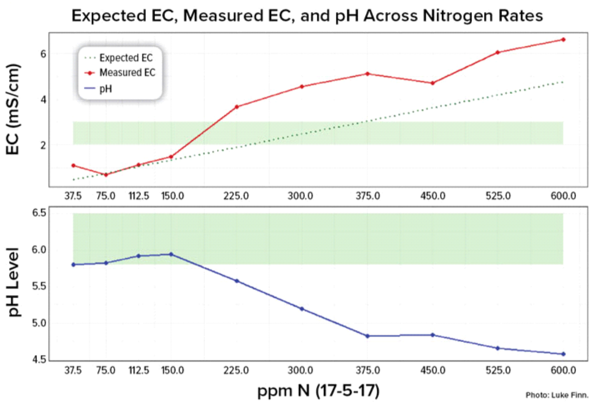

Photo: Luke Finn.

Geraniums (*Pelargonium x hortorum*) consistently rank among the top five best-selling annual bedding plants in the United States and growers aim to produce a high-quality, shelf-ready crop while minimizing inputs. Fertilization strategies vary widely, yet achieving a balance between efficiency, cost-effectiveness, environmental responsibility, and stable substrate pH and electrical conductivity (EC) remains a persistent challenge.

Fertility recommendations for geraniums have evolved over time with the introduction of new varieties and modernized cultural practices. A historical recommendation from Penn State University in 1982 suggests fertilizer should be applied weekly at 536 ppm nitrogen (N), while Ball's geranium grower's manual from 1993 suggests N concentrations of 100 to 140 mg·L–1 N for 4- to 5-in. pots and 120 to 180 mg·L–1 N for 6-in. or larger pots. Current growing recommendations call for fertilization rates of 150 to 200 mg·L–1 N.

With increased variation among geranium cultivars, as well as constant concern with greenhouse inputs, as part of an American Floral Endowment-funded study on revising leaf tissue nutrient recommendations, we at North Carolina State University grew geraniums at 10 different rates of nitrogen to determine the effects on plant growth. In the fertility trial, we wanted to obtain leaf tissue samples over the wide nutrient range, and as a bonus, we investigated optimal nitrogen concentration for balanced growth and to dial in substrate pH and EC values (Figure 1). We're sharing the pH, EC and growth aspects here.

Smaller shoot growth was observed at both low (≤112.5 ppm N) and excessive (≥375 ppm N) fertilizer rates, while optimal growth occurred within a moderate range (150 to 300 ppm N). A critical component of producing a high-quality crop is consistent monitoring and management of substrate EC and pH, both of which can be heavily affected by fertilizer. In Figure 1, the Expected EC Concentration (green dotted line) increased as the rate increased from 0.465 mS/cm with 37.5 ppm N to 4.74 mS/cm with 600 ppm N. The Measured EC (solid red line) began elevated compared to what was expected, likely due to plants being stunted and accumulating salts at the time of measurement.

Following this, the Measured EC followed the Expected EC Concentration up until 225 ppm N was applied. Above 225 ppm N, the PourThru substrate EC values then spiked upward. This represents the accumulation of excessive fertility beyond plant uptake capacity. This is a key point in determining the maximum fertilizer rate that should be applied to geraniums. Rates greater than 225 ppm N represent wasted fertilizer dollars that aren't contributing to improvements in plant growth.

Figure 2. Interveinal chlorosis of the upper foliage is a typical symptom of elevated substrate pH. Also note that over-irrigation, cold growing or root rot can also limit iron uptake and result in the development of symptoms.

Figure 3. Chlorosis and necrotic spotting of the lower foliage are typical symptoms of low substrate pH. This is often a result of iron and/or manganese or micro-nutrient toxicities.

Photos: Patrick Veazie.

Another key aspect to highlight is what excessive fertility does to the substrate pH. All fertilizers [acidic (NH4-N+urea), neutral and basic (NO3-N) reacting] are, from a formulation standpoint, acidic in nature and require plant uptake for the biological reaction. Therefore, when fertility rates become excessive, substrate pH will subsequently drop. This effect can be observed in Figure 1 with the blue solid PourThru Substrate pH line. Once the fertilizer rate exceeded the uptake amount, the substrate pH dropped. These trends confirm earlier work by Ka Yeon Jeong et al. at NC State University, which illustrated how higher rates of a basic fertilizer can drop the substrate pH.

When substrate EC and pH values are outside recommended ranges, it can lead to nutrient imbalances, reduced uptake efficiency and visible foliar symptoms. This is especially important in geraniums, as they're highly susceptible to both low and high pH problems. Excessively high substrate pH will result in interveinal chlorosis of the upper leaves, often caused by an iron (Fe) deficiency (Figure 2). It's important to inspect the plant and monitor the substrate, as iron chlorosis can also occur if the plants are grown in a cold environment, irrigated excessively or are experiencing root rot. On the other hand, low substrate pH will typically result in an iron and/or manganese toxicity, as well as stalled growth (Figure 3). Nutritional guidebooks for geranium ("Geraniums IV" and "Plant Root Zone Management") are readily available and allow the grower to see a disorder deficiency or toxicity image.

It's critical to apply ample fertility to achieve the desired plant growth, while being conscious to avoid over-fertilization, and in turn, avoid negatively impacting substrate pH. Overall, successful geranium nutrition requires a balanced approach that ties in appropriate fertilizer rates, consistent substrate pH and EC monitoring, and informed decision-making. Growers should aim to create a plan that best suits their needs and production system.

This research was sponsored by the American Floral Endowment. The next steps will be analyzing geranium tissue values to provide refined leaf tissue nutrient standards based on large sample sizes and meta-analysis. These values will be utilized in creating grower-friendly tools. **GT**

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