



Figure 2. Nitrogen (N) deficiency on lower leaves of foxglove (*Digitalis purpurea* 'Camelot Lavender').

Herbaceous Perennial Nutrition 101

Regardless of your production challenges, keeping containerized herbaceous perennials healthy is as simple as understanding the basics of their nutritional needs.

By W. Garrett Owen

Managing containerized herbaceous perennial nutrition and understanding the crops' needs can be difficult if the proper tools are not available in a grower's tool kit. The difficulty of managing nutrition of herbaceous perennials is often the diversity and fertility requirements among perennial species, growing season, and the production facilities, such as greenhouses, shade houses, or outdoor container nurseries. To help you keep your plants healthy and productive, this article will discuss the basics of managing, monitoring, and understanding containerized herbaceous perennial nutrition.

Fertility

Nutrients are provided to containerized herbaceous perennials in a variety of methods, such as water-soluble feed (fertigation), or by incorporating or top-dressing the substrate with

controlled- or slow-release fertilizers. Irrespective of how nutrients are supplied, plants require primary [nitrogen (N), phosphorus (P), and potassium (K)] and secondary [calcium (Ca), magnesium (Mg), and sulfur (S)] macronutrients to develop and grow, though these nutrients are often depleted in the substrate and need to be frequently replenished.

To replenish these nutrients, growers can select from a wide range of commercially available fertilizers. When selecting a fertilizer, consider the form of N being applied, whether it is ammonium, nitrate, or urea, because plants respond to each N form differently. For example, plants fertilized with high concentrations of ammoniacal- or urea-N often display soft, lush growth because of rapid leaf expansion and internode elongation.



Figure 1. Phosphorus (P) deficiency on lower leaves of blanketflower (*Gaillardia aristata* 'Arizona Sunset').

Photos by W. Garrett Owen.

Furthermore, flower and root development are diminished.

In contrast, plants fertilized with high concentrations of nitrate-N tend to be toned or compact without any negative effects on flower or root development.

So which fertilizer is best for you? There is no right or wrong answer, but growers should consider the following when selecting a fertilizer:

- N form
- Solubility
- Acidic or basic properties
- Release time or longevity (controlled- or slow-release fertilizers)

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Figure 3. Young developing leaves of garden mum (*Chrysanthemum* sp.) exhibit interveinal chlorosis (yellowing) because of high pH induced iron (Fe) deficiency.

Furthermore, not all fertilizers are the same, and a complete fertilizer may not supply all the nutrients in adequate amounts for plant growth. For example, not all water-soluble fertilizers contain large amounts of Ca and Mg. Growers often rotate between acidic fertilizers that contain little Ca and Mg and basic nitrate-N fertilizers that contain Ca, but limited Mg. Therefore, growers can supplement Mg by applying Epsom salts monthly at the rate of 1 pound per

you purchase pre-mixed or blend your own substrate.

Initial substrate pH can be determined by conducting either the saturated media extraction (SME) or 2:1 (substrate:distilled water) extraction methods. Determining the initial substrate pH will allow growers to adjust pH by amending substrates with limestone to achieve an optimal pH of 5.6 to 6.2 for containerized perennials. The optimal pH may be species-specific.

What influences pH throughout production? Substrate pH is influenced by:

- Substrate amended with limestone
- Fertilizer properties
- Irrigation water alkalinity
- Plant roots

Substrate pH defines how available nutrients are to plants. In general, macronutrients are less likely to be influenced by substrate pH; however, for micronutrients this is a different story. Substrate pH influences the availability of micronutrients, for example, iron (Fe) and manganese (Mn).

High substrate pH limits mobility of Fe to young developing leaves, thus resulting in Fe deficiency or interveinal chlorosis (yellowing) (Figure 3). While at low substrate pH, Fe and Mn accumulate in the older (lower) leaves and may result in Fe/Mn toxicity. To produce healthy and marketable plants, growers should monitor the pH using Pour-Thru or SME methods to ensure pH has not fallen or risen above the optimal range.

Water

Contrary to belief, substrate pH is primarily influenced by the irrigation water alkalinity level and not the pH. Irrigation water alkalinity (i.e., dissolved carbonates such as calcium carbonate [CaCO₃] and bicarbonates {calcium [Ca(HCO₃)₂], magnesium [Mg(HCO₃)₂], and sodium [NaHCO₃] bicarbonates}) is the major regulator that influences pH rise in substrates. Irrigation water containing high alkalinity levels will increase the substrate pH, thus inducing chlorosis of the upper leaves. Hence, growers should monitor irrigation water alkalinity by submitting water samples



- Handling procedures
- Experience
- Price

Growers should also consider the plant response to the fertilizer being applied. As mentioned before, this can be influenced by the N form, but also by P, which can control plant height when limited.

Limiting or providing excessive nutrients may result in deficient (Figure 1) or toxic symptoms, respectively. For instance, growers who provide 50 ppm N may observe chlorotic plants (Figure 2), while at 700 ppm N, plants may display toxicity symptoms. Typically, 100 to 300 ppm N is adequate for proper plant growth, but may vary by species.



Figure 4. In-house testing of irrigation water will help you determine alkalinity.

100 gallons of water. Calcium and Mg are also available to plants from calcitic or dolomitic limestone used to adjust substrate pH or from the irrigation water, though these nutrients are typically available in small amounts and growers should not depend upon these sources to provide plants with adequate Ca and Mg.

Substrate

Containerized herbaceous perennials are grown in substrates composed mostly of either peat, coir, or composted softwood bark, or a combination of these components. The pH of these components in combination with the moisture content of the substrate determines the pH. For example, the pH of peat may range from 3.0 to 4.0, while coir may range from a pH of 4.9 to 6.8. Therefore, it is important to determine initial substrate pH prior to transplant, regardless of if

Grower Resources Available on e-GRO

Are you interested in learning more about how to determine and monitor pH and calculate alkalinity for better perennial nutrition? There are several great resources available on e-GRO (Electronic Grower Resources Online/**E-Gro.org**), which offers free educational materials and learning tools for anybody involved in greenhouse plant production.

- Saturated Media Extraction or 2:1 (substrate:distilled water) Extraction: <https://goo.gl/hRrEez> or <https://goo.gl/pZMwLR>
- Pour-Thru Method: <https://goo.gl/wqCL69>
- AlkCalc: <https://goo.gl/cvcgCu>

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for lab analysis or conduct in-house alkalinity testing (Figure 4).

Determining and monitoring the irrigation water alkalinity will allow growers to make informed decisions such as acidifying or neutralizing the irrigation water to reduce alkalinity (Figure 5).

Generally, growers should maintain an alkalinity of 80 to 120 ppm CaCO_3 for containerized herbaceous perennials. The most common acid used to neutralize irrigation water is sulfuric, but nitric and phosphoric acids are often used.

How much acid do you need to neutralize irrigation water alkalinity? The collaborative group of floriculture specialists called e-GRO established AlkCalc (see sidebar), an interactive calculator, which assists growers in making corrective decisions. AlkCalc calculates the amount of acid needed to add to irrigation water in order to modify the pH and alkalinity levels. Of course, growers will need to know their current irrigation water pH and alkalinity levels, and which acid they plan to use.

Managing, monitoring, and understanding nutrition of containerized herbaceous perennials does not need to be a daunting task. Understanding basic plant needs and nutrition will allow you to choose the right fertilizer(s) for your operation. Additionally, monitoring substrate pH and irrigation water alkalinity will allow you to establish the tools to manage and grow healthy containerized herbaceous perennial crops. For more information on perennial nutrition, refer to *Perennial Solutions: A Grower's Guide to Perennial Production*, by Paul Pilon. **GG**



Figure 5. Growers often use acid injection systems to neutralize irrigation alkalinity.



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