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Nutrient Management Strategies for Ensuring Blue Coloration of Greenhouse Hydrangeas

The blue coloration in hydrangeas is the result of managing three primary factors: applying aluminum sulfate, lowering the substrate pH to the range of 5.2 to 5.5, and limiting phosphorus applications. This e-GRO Alert discusses the target parameters so you won't be singing the hydrangea blues. Link to: Blue Coloration video.

As growers begin the process of forcing greenhouse hydrangeas (*Hydrangea macrophylla*) there are a few nutrient management factors that need to be addressed early on. It should be determined if blue or pink flowers will be produced and a specific management plan should be put in place to achieve the desired color. Failure to plan or follow through with this fertilization strategy can result in purple or any undesired color between blue and pink (Figs. 1&2).

There are six main factors to manage to enhance the development of blue coloration in hydrangeas (Fig. 3). Each of these factors are discussed in this article so you can include them in your management plan.

Figure 1. If the requirements for inducing blue coloration are not met, hydrangea flowers can range from blue to purple or pink.

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Factor 1: Substrate pH

Managing and monitoring substrate pH is vital in achieving the desired color of the hydrangea bloom, but it is not the pH that induces this color distinction. Hydrangea sepals contain an anthocyanin pigment that gives the flower its color. The pigment is naturally red, but a reaction with aluminum results in the blue coloring. Aluminum (Al) availability is determined by the pH of the substrate. When a pink color is desired the recommended substrate pH is 5.8-6.2. Maintaining a substrate pH in this range will tie up any potential Al in the substrate and promote a brighter pink flower. There is an upper limit to the optimal pH range. When the substrate pH exceeds 6.5, iron deficiencies can occur and should be avoided (Fig. 4).

For growers who are producing a blue flower, a lower pH of 5.2-5.5 is recommended, which increases Al availability to the plant. The substrate pH should be monitored regularly during production to maintain the desired range.

Factor 2: Aluminum Sulfate Applications

Once growers have taken the appropriate steps to achieve the desired pH, an adequate supply of Al must be available to the plant too. Aluminum should only be applied to plants during the forcing process when a blue


Figure 2. “Blurple” is the term used when a more purple coloration develops instead of blue.

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flower is desired. Note that some hydrangea plants may have received Al applications prior to being shipped. These pre-dormancy Al applications do not guarantee a blue flower when the plants are forced into bloom the following spring. To ensure the plant has adequate supply of Al it is important to begin Al applications very early in the production cycle. All Al applications should be completed within the first 5 to 6 weeks of forcing. The current recommendation to supply Al to the plant is by applying $AlSO_4$ at 10-15 pounds per 100 gallons of water (see Table 1 for conversion rates). This should be done every 10-14 days and typically 3 or 4 applications are made. The leaves should be rinsed after an application to avoid any possible burn.

Excess applications of $AlSO_4$ can result in leaf scorch, root damage, and plant death. Hydrangea roots are sensitive to high salt levels and thus the electrical conductivity (EC) should be monitored during this process to prevent root stress. EC levels should not exceed 2.5 to 3.0 mS/cm to help avoid root and leaf burn.

Slow Release Polymer Coated Aluminum Sulfate

An alternative is to apply a slow release aluminum sulfate product. Greenhouse growers often use a 3-month formulation. For a 15% Al formulation, a rate of 1 teaspoon per 8-inch pot is used by many growers in North Carolina. Substrate incorporation may be more effective than top dressing if the plants are on a drip irrigation system. Rates will vary by product used, cultural practices, and location, so read and follow the label recommendations for your region.

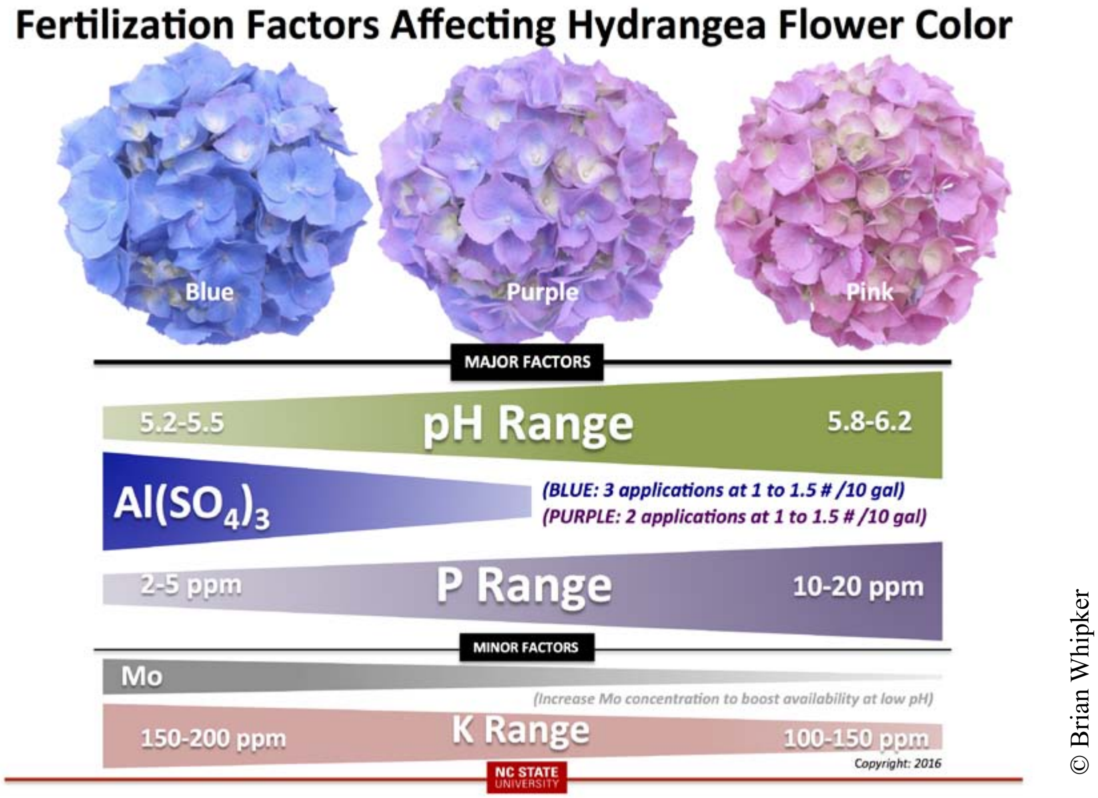

Figure 3. A graphical representation of the factors that affect blue and pink coloration in hydrangeas.

Factor 3: Low Phosphorus Fertilization Rates

Monitoring pH and applying aluminum is not considered a complete hydrangea nutrient management plan. Phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and molybdenum (Mo) are also nutrients that need specific monitoring during this process.

Figure 4. When the substrate pH exceeds 6.5, iron chlorosis of the younger leaves can occur. Over irrigation and root rot can also hinder iron uptake by the plant.

Phosphorus is an essential nutrient for plant growth, but high levels of P in the substrate will compete with Al for uptake. Therefore, only a small amount of P should be applied to blue flowering plants. The recommended range of P in the substrate is 2-5 ppm for blue flowers and 10-20 ppm for pink flowers. If you are injecting acid for alkalinity neutralization, then phosphoric acid should be avoided because the level of P supplied will exceed 5 ppm and hinder the development of the blue coloration.

Factor 4: Slightly Higher Potassium Fertilization Rates

Potassium levels also have an impact on flower color. Higher levels of K ranging from 150-200 ppm are recommended for blue flowers and a slightly lower range of 100-150 ppm is recommended for pink and white flowers. A fertilizer ratio of 5 N : 1 P_2O_5 : 6 K_2O is recommended for blue flowers and 5 N : 2 P_2O_5 : 2 K_2O is recommended for pink flowers.

Factor 5: Provide Adequate Molybdenum

While Mo does not have a direct effect on the color of the flower it can become less available at lower pH (Fig. 5). Additional Mo may need to be applied when a lower substrate pH range of 5.2-5.5 is used for enhancing blue coloration.

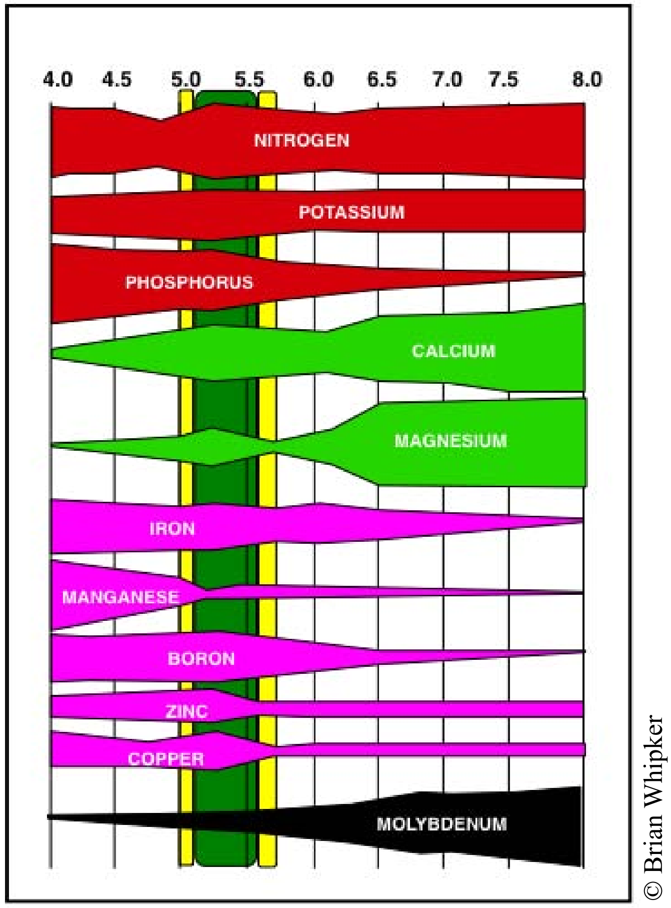

Figure 5. Molybdenum (Mo) decreases as the substrate pH becomes more acidic when blue hydrangeas are being grown. Calcium (Ca) and magnesium (Mg) are also less available at lower substrate pHs. Therefore, make sure to supply Ca, Mg, and Mo in your fertilization program to ensure adequate levels are available.

These nutrient levels can be monitored throughout the production cycle by sending Pour Thru or leaf tissue sample to a state or commercial lab for a complete nutrient analysis.

Factor 6: Provide Adequate Ca and Mg

The availability of both Ca and Mg is less at the lower pH range of 5.2-5.5 recommended for growing blue hydrangeas (Fig. 5). In addition, lower rates of limestone are added to the substrate to achieve this lower substrate pH range. This will result in less Ca and Mg being available to the plants. Therefore make sure that adequate levels of those two elements are supplied either from your irrigation water or in your fertilization program.

In summary pink hydrangea flowers need a higher substrate pH of 5.8-6.2, no $AlSO_4$ applications, higher P and lower K rates. Blue flowers will require a lower substrate pH of 5.2-5.5, early and adequate $AlSO_4$ applications, very low P (2-5 ppm P), higher K rates, and potentially an additional Mo application.

Table 1. Conversion factors from U.S. units to metric units for mixing $AlSO_4$ at 10 to 15 pounds per 100 gallons of water and calculated for large, medium, and small volumes of water.

Volume	Lower Rate Range	Upper Rate Range
Larger Volume	10 pounds / 100 gallons	15 pounds / 100 gallons
	4.54 kg / 100 gallons	6.81 kg / 100 gallons
	1.198 kg / 100 liters	1.797 kg / 100 liters
Medium Volume	16 oz / 10 gallons	24 oz / 10 gallons
	453.6 g / 10 gallons	680.4 g / 10 gallons
	119.8 g / 10 liters	179.7 g / 10 liters
Smaller Volume	1.6 oz / gallon	2.4 oz / gallon
	45.36 g / gallon	68.04 g / gallon
	11.98 g / liter	17.97 g / liter