e-GRO Nutritional Monitoring



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Nutritional Monitoring Series

Cineraria

(Pericallis ×hybrida)

Cineraria require low fertility of 100 to 150 ppm N. They prefer a pH within the range of 5.8 to 6.2. Substrate pH values above 6.2 can inhibit iron availability and induce interveinal chlorosis or yellowing of the upper foliage.

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Figure 1A. High substrate pH above 6.2 will inhibit iron (Fe) uptake causing newly developed and recently matured leaves to become Fe-deficient and exhibit marginal chlorosis (yellowing). Photos by: W. Garrett Owen

Cineraria

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Low
100 to 150 ppm N

EC Category A:
1:2 Extraction:
0.4 to 0.6 mS/cm

SME:
0.9 to 1.3 mS/cm

PourThru:
1.3 to 2.0 mS/cm

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Figure 1B. High substrate pH above 6.2 will inhibit iron (Fe) uptake causing newly developed and recently matured leaves to become Fe-deficient and exhibit marginal chlorosis (yellowing). Photos by: W. Garrett Owen

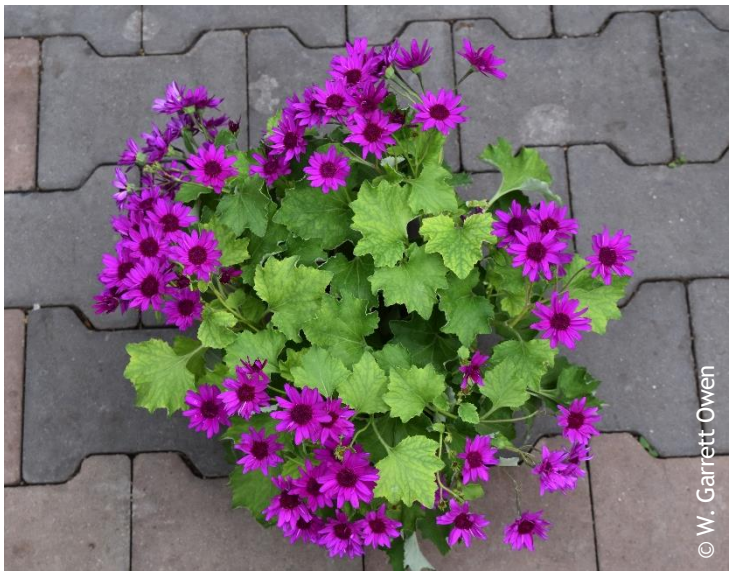

Figure 2A. High substrate pH above 6.2 will inhibit iron (Fe) uptake causing newly developed and recently matured leaves to become Fe-deficient and exhibit interveinal chlorosis (yellowing). Photos by: W. Garrett Owen

Fertility Management of Cineraria

A common challenge during cineraria production is chlorosis (yellowing) of the upper foliage. Chlorosis may develop due to high or low substrate pH (Hammer, 1997; Heins et al., 1991). Cineraria should be grown with a pH range of 5.8 to 6.2. Tissue nutrient levels found in healthy, newly expanded leaves and critical tissue values of cineraria are listed in Table 1. These ranges will enable growers to avoid nutritional disorders.

Substrate pH above 6.2 will inhibit iron (Fe) uptake, causing newly developed and recently matured leaves to become Fe-deficient and exhibit marginal (Fig. 1A-B) and interveinal chlorosis (Fig. 2A-B). If plants become severely Fe-deficient, interveinal chlorosis intensifies. Corrective procedures for high substrate pH should begin within the range of 6.2 to 6.4. Maintaining substrate pH below 6.2 will reduce the likelihood of Fe deficiency from occurring; monthly drench applications of micronutrients may be used to provide additional micronutrients (Feuerbach, 2017). Suntory® Flowers Limited (2017) recommends the addition of Fe-chelate in the form of EDTA or EDDHA trace elements to liquid feed stock solution at a rate of 1000 ppm (1 g/L) and feed at an injector ratio of 1:100, thus reducing the likelihood of Fe deficiency from occurring.

Substrate pH below 5.8 will inhibit magnesium (Mg) uptake causing lower or older leaves to become Mg-deficient and exhibit interveinal chlorosis (Fig. 3) and leaf margins can also become necrotic (dead; Fig. 4). Corrective procedures for low substrate pH should begin within the range of 5.5 to 5.8. Monthly applications of supplemental Mg in the form of magnesium sulfate (MgSO4; Epsom salts) at a rate of 8 oz./100 gallons of water in areas with naturally occurring Mg in the water supply or 16 oz./100 gallons of water in areas lacking Mg in the irrigation water (Whipker, personal communications) will prevent

Mg deficiency (Hammer, 1997) and symptomology development.

After initial transplant and during the first four weeks of production, provide constant fertilization of 250 ppm N (Suntory, 2017). After cinerarias are established, they are considered to require low fertility. Cinerarias should be provided with constant fertilization at 100 ppm N and potassium (K) plus phosphorus (P) (Hammer, 1997) or 200 ppm N at every other irrigation (Heins et al., 1991). The addition of a slow- or controlled-release fertilizer will provide nutrition during periods of slow growth (low light conditions) and when liquid fertilizations are not frequent enough due to low water requirements (Suntory® Flowers Limited, 2017).

Substrate EC should stay below 0.6, 1.3, or 2.0 mS/cm, based on the 1:2 Extraction, SME, or PourThru methods, respectively. If levels begin to increase, switch to clear water irrigations to avoid a build up of fertilizer salts in the substrate. If EC levels become excessive, then leach the substrate with clear irrigation water twice before providing fertility. It is best to monitor the crop to avoid excessive EC levels than to waste fertilizer by having to leach it out of the pots.

Avoid fertilizers providing ammonium (NH_4-N) such as 20-10-20 or 20-20-20. The use of 20-10-20 still remains in the recommendations of many suppliers, but because of the concern with NH_4 toxicity it should be avoided. Cinerarias are sensitive to high levels of ammonium and limiting ammonium sources of fertilizer

Figure 2B. High substrate pH above 6.2 will inhibit iron (Fe) uptake causing newly developed and recently matured leaves to become Fe-deficient and exhibit interveinal chlorosis (yellowing). Photos by: W. Garrett Owen

Figure 3. Low substrate pH below 5.8 inhibits magnesium (Mg) uptake causing lower or older leaves to become Mg-deficient and exhibit interveinal chlorosis (yellowing). Photo by: W. Garrett Owen

Figure 4. Low substrate pH below 5.8 inhibits magnesium (Mg) uptake causing lower or older leaves to become Mg-deficient and exhibit interveinal chlorosis (yellowing) and leaf margin necrosis (death). Photo by: W. Garrett Owen

will reduce the possibility of NH_4 toxicity from occurring (Hammer, 1997). Ammoniacal-based fertilizers will cause excessive vegetative growth and leaf expansion (Fig. 5). Nau (1984) reported high levels of NH4 will cause leaf rolling and leaves will turn silvery-green. Additionally, during production in warmer weather, plants require frequent irrigations and thus, boron (B) deficiency can occur. Symptomology of B-deficient plants include distorted, mottled leaves and stunted plant growth (Dole and Wilkins, 2005).

Therefore, it is important to provide cinerarias with low (100 to 150 ppm N) fertility during crop production and to limit ammoniacal-based fertilizers.

Summary

Providing cinerarias with low fertility ranging 100 to 150 ppm N and maintaining a substrate pH of 5.8 to 6.2 will prevent most nutritional disorders.

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Figure 5. Cinerarias are sensitive to high levels of ammonium (NH4-N) and ammoniacal-based fertilizers (20-10-20 or 20-20-20) will cause excessive vegetative growth and leaf expansion. Photo by: W. Garrett Owen

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Table 1. Leaf tissue nutrient analysis for cineraria (*Pericallis ×hybrida* 'Jester Pure Blue') grown under nutrient sufficient and deficient conditions to determine critical tissue nutrient levels.

Element		**Reference Cineraria [1]**	**Critical tissue nutrient [1]**
Nitrogen (N)	(%)	6.96	<6.96
Phosphorus (P)		1.02	0.14
Potassium (K)		8.68	1.10
Calcium (Ca)		1.87	0.37
Magnesium (Mg)		0.64	0.15
Sulfur (S)		0.52	0.18
Iron (Fe)	(ppm)	85.1	64.3
Manganese (Mn)		116.4	14.0
Zinc (Zn)		21.6	15.7
Copper (Cu)		16.9	6.3
Boron (B)		52.1	12.1
[1] Source: Barnes et al. (2015)			

Corrective Procedures for Modifying Substrate pH and Electrical Conductivity (EC)

When the pH or substrate electrical conductivity (EC) drifts into unwanted territory, adjustments must be made. Below are the standard corrective procedures used to modify the substrate pH and EC for greenhouse grown crops in soilless substrates.

1. Low Substrate pH Correction

When Fe and Mn toxicity becomes a problem, adjust (raising) substrate pH to the recommended pH range. Corrective procedures to raise low pH levels are listed below. Switching to a basic fertilizer when the substrate pH is nearing the lower limit will help stabilize the pH. If the pH is below the recommended range, then corrective procedures will need to be implemented. Flowable lime is one option. Using a rate of 2 quarts per 100 gallons of water will typically increase the substrate pH by roughly 0.5 pH units. Two quarts can be used through an injector. Additional applications can be made if needed. Potassium bicarbonate ($KHCO_3$) can also be applied. A rate of 2 pounds per 100 gallons of water will increase the substrate pH by roughly 0.8 pH units. This treatment will also provide excessive potassium (K) and cause a spike in the substrate EC. A leaching irrigation with clear water is required the following day to restore the nutrient balance (the ratio of K:Ca:Mg) and lower the EC. As always, remember to recheck your substrate pH to determine if reapplications are needed.

pH Adjustment Recommendations

Flowable Lime

- Use 1 to 2 quarts per 100 gallons of water.
  Rinse foliage.
- Avoid damage to your injector by using rates of 2 quarts per 100 gallons of water, or less.
- Can split applications.

Hydrated Lime

- Mix 1 pound in 3 to 5 gallons of WARM water. Mix twice. Let settle. Decant liquid and apply through injector at 1:15.
- Caustic (rinse foliage ASAP and avoid skin contact)

Potassium Bicarbonate ($KHCO_3$)

- Use 2 pounds per 100 gallons of water
- Rinse foliage immediately.
- *Provides 933 ppm K.*
- Leach heavily the following day with a complete fertilizer to reduce substrate EC and restore nutrient balance.
- Rates greater than 2 pounds per 100 gallons of water can cause phytotoxicity!

2. High Substrate pH Correction

The target pH for many species is between 5.8 and 6.2. Higher pH values will result in Fe deficiency and lead to the development of interveinal chlorosis on the upper leaves. Check the substrate pH to determine if it is too high. Be careful when lowering the substrate pH, because going too low can be much more problematic and difficult to deal with.

Acid-based Fertilizer
If the substrate pH is just beginning to increase, then first consider switching to an acidic-based fertilizer. These ammoniacal-nitrogen (N) based fertilizers are naturally acidic and plant nitrogen uptake will help moderate the substrate pH over a week or two.

Acid Water Drench
Some growers use this intermediate correction if pH levels are not excessively high and a quick lower of the substrate pH is desired. Use sulfuric acid to acidify your irrigation water to a pH 4.0 to 4.5. Apply this acid water as a substrate drench providing 5 to 10% excessive leaching of the substrate. Rinse the foliage to avoid phytotoxicity. Results should be visible within 5 days. Retest the substrate pH and repeat if needed.

Iron Drench
If the levels are excessively high, then an Fe chelate application can be made to the substrate.
Below are the options.

Iron Chelate Drench (options)
- Iron-EDDHA: mix 5 ounces in 100 gallons of water
- Iron-DTPA: mix 5 ounces in 100 gallons of water
- Iron sulfate: mix 4-8 ounces in 100 gallons of water

- Apply as a substrate drench with sufficient volume to leach the pot.
- Rinse foliage immediately.
- Avoid use on iron efficient plants (geraniums).

3. Low EC Correction

If low EC problems occur, increase the fertilization rate to 300 ppm N for a few applications before returning to the recommend fertilization rate for the crop.

4. High EC Correction

Excessively high fertilization rates will result in a marginal leaf burn. Check the substrate EC to confirm your diagnosis. Values greater than 6.0 mS/cm based on the PourThru sampling method can be problematic for many plants.

Switch to Clear Water Irrigations
If the substrate EC is just beginning to increase over time, then leach with a few clear water irrigations to lower EC levels by flushing out the salts.

Clear Water Leaching
If the EC values are excessively high, leach the substrate twice with back-to-back clear water irrigations. Then allow the substrate to dry down normally before retesting the EC. If EC levels are still too high, repeat the double leach. Once the substrate EC is back within the normal range, use a balanced fertilizer at a rate of 150 to 200 ppm N.

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