e-GRO Nutritional Monitoring


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Nutritional Monitoring Series

Lobelia

(*Lobelia erinus*)

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Lobelia requires moderate fertility of 150 to 200 ppm N. Insufficient fertility results in stunted plants with lower chlorotic (yellow) foliage. Overfertilization results in excessive plant growth. Optimal substrate pH values for lobelia range from 5.8 to 6.2. Substrate pH above 6.2 induces interveinal chlorosis and stunted plant growth.

Figure 1. High substrate pH above 6.5 can inhibit iron (Fe) uptake causing newly developed and recently matured leaves of lobelia (*Lobelia erinus*) to become Fe-deficient and exhibit interveinal chlorosis (yellowing). Photo by: W. Garrett Owen.

Lobelia

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Medium
150 – 200 ppm N

EC Category B:
1:2 Extraction:
0.6 to 0.9 mS/cm

SME:
1.3 to 2.0 mS/cm

PourThru:
2.0 to 3.0 mS/cm

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Figure 2. High substrate pH above 6.5 inhibits iron (Fe) uptake causing lobelia (*Lobelia erinus*) to become Fe-deficient and exhibited as intensified interveinal chlorosis (yellowing). Photo by: Brian Whipker.

Figure 3. Substrate pH above 6.5 can typically inhibit plant growth, but no negative plant growth symptoms were observed in research trials with lobelia (*Lobelia erinus*). Photo by: W. Garrett Owen.

Fertility Management of Lobelia

Lobelia should be grown with a substrate pH range of 5.8 to 6.2. Use recommended 1:2 Extraction, SME, or PourThru methods to determine and monitor substrate pH and soluble salts [referred to as electrical conductivity (EC)] values. Additionally, conduct routine foliar analysis tests to monitor crop nutrient status. Leaf tissue nutrient levels found in leaves of lobelia 'Bella Aqua' plants at 3 and 7 weeks after transplant and grown in a peat-based substrate provided with 150 or 250 ppm nitrogen (N) derived from an equal N mixture of 20-10-20 and 13-2-13 fertilizers are provided in Table 1, which can serve as a guideline in diagnosing suspected nutrient disorders. Monitoring substrate pH and nutrient status will enable growers to avoid pH induced nutritional disorders.

Substrate pH below 5.8 can result in an increase uptake of iron (Fe) and manganese (Mn) to toxic levels which will accumulate in leaf tissue. While no low pH-induce symptoms have been reported for lobelia, corrective procedures should begin around 5.6. Furthermore, substrate pH below 5.4 to 5.6 will inhibit magnesium (Mg) uptake causing lower or older leaves to become Mg-deficient and exhibit interveinal chlorosis (yellowing). Monthly applications of supplemental Mg in the form of magnesium sulfate ($MgSO_4$; Epsom salts) at a rate of 8 oz./100 gal. of water in areas with naturally occurring Mg in the water supply or 16 oz./100 gal. of water in areas lacking Mg in the irrigation water will prevent Mg deficiency and symptomology development.

High substrate pH above 6.5 can inhibit Fe uptake causing newly developed and recently matured leaves to become Fe-deficient. During University of Kentucky (UK) research trials, interveinal chlorosis (yellowing; Fig. 1) was observed. Over time, interveinal chlorosis will intensify (Fig. 2). In UK trials, stunted plant growth was not observed (Fig. 3).

Figure 4. Providing insufficient fertility [low electrical conductivity (EC)] during lobelia (*Lobelia erinus*) production can result in lower chlorotic (yellow) foliage. Photo by: Brian Whipker.

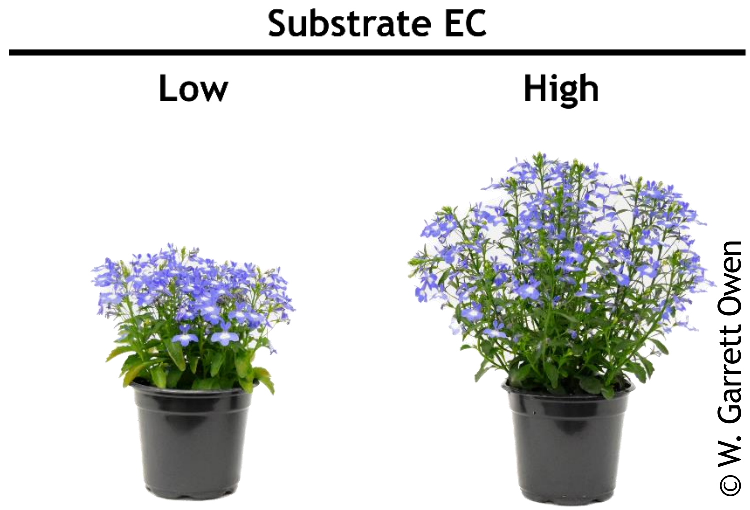

Figure 5. Providing insufficient fertility [low electrical conductivity (EC)] during lobelia (*Lobelia erinus*) production results in poorly branched plants (left), while excessive fertility [high EC] can result in excessive plant growth (right). Image by: W. Garrett Owen.

Stunted plant growth can also be a symptom of high substrate pH. Should substrate pH begin to rise above 6.2, then a corrective action is needed to ensure nutrient availability and uptake for optimal plant growth.

Lobelia can be propagated from seed or vegetative cuttings. For seed propagated lobelia, fertilization can begin during Stage 2 [radical, hypocotyl (stem), and cotyledons (seedling leaves) emergence] of plug production. Begin providing 50 to 75 ppm nitrogen (N). At Stage 3 (true leaves develop), increase fertility and provide weekly applications of 100 to 150 ppm N delivered from a 20-10-20 fertilizer and alternate with 14-0-14 (Nau, 2021). Maintain the fertility regime during Stage 4 (toning or hardening off for transplant). Once plugs are transplanted into their final containers, begin providing a moderate level of fertility. A constant liquid feed program of 150 to 200 ppm N delivered by a 20-10-20 fertilizer is recommended. Nau (2021) reported alternating 20-10-20 with a 15-0-15 fertilizer.

During vegetative cutting propagation, a fertility program can begin when lobelia cuttings develop callus. Nau (2021) recommended providing 50 to 75 ppm N delivered from a 20-10-20 once a week. As root initials and adventitious roots develop, increase fertility to a range of 100 to 150 ppm N delivered weekly from a 20-10-10 fertilizer and alternate with 15-0-15. To tone cuttings, increase fertility to 150 to 200 ppm N delivered weekly from a 20-10-10 fertilizer and alternate with 15-0-15. Once liners are transplanted into their final containers, begin providing a moderate fertilization rate of 150 to 200 ppm N. Nau (2021) reported providing a constant liquid fertilization rate of 200 to 300 ppm N, but warned against soluble salt accumulation in the substrate and recommended leaching. Therefore, to prevent soluble salt accumulation and eliminate

Table 1. Foliar nutrient concentration survey ranges of lobelia 'Bella Aqua' (*Lobelia erinus*) plants at 3 and 7 weeks after transplant and grown in a peat-based substrate provided with 150 or 250 ppm nitrogen (N) derived from an equal N mixture of 20-10-20 and 13-2-13 fertilizers.

Element		**Survey Ranges [1]**	
		Weeks after transplant	
		3	**7**
Nitrogen (N)	(%)	4.38 – 4.65	3.02 – 3.48
Phosphorus (P)		0.45 – 0.47	0.24 – 0.38
Potassium (K)		3.45 – 3.57	1.93 – 3.62
Calcium (Ca)		0.55 – 0.59	0.49 – 0.64
Magnesium (Mg)		0.39 – 0.44	0.32 – 0.35
Sulfur (S)		0.38 – 0.39	0.23 – 0.27
Iron (Fe)	(ppm)	74.7 – 76.7	71.5 – 249
Manganese (Mn)		68.3 – 71.3	51.0 – 72.1
Zinc (Zn)		93.3 – 112	55.7 – 61.2
Copper (Cu)		6.05 – 6.34	4.12 – 5.96
Boron (B)		23.7 – 27.1	22.1 – 26.7
Sodium (Na)		0.17 – 0.21	0.18 – 0.28

Source: [1] Whipker et al. (2019)

reduce the likelihood of overfertilizing and wasting fertilizer, growers should consider providing the aforementioned fertilization rate of 150 to 200 ppm N. In general, fertilize with 20-10-20 and alternate with 15-0-15.

During lobelia production, insufficient fertility levels (low EC) will often result in stunted plant growth with chlorotic foliage (Fig. 4). Nau (2021) reported low fertility concentrations early in the crop cycle will result in poorly branched plants (Fig. 4). Overfertilization (high EC) results in excessive plant growth (Fig. 5). If EC values become excessive, leach the substrate with clear irrigation water twice before providing fertility. It is best to monitor the crop to avoid excessive EC values than to waste fertilizer by leaching it from the pots.

Summary

Providing moderate fertility at 150 to 200 ppm N and maintaining a pH of 5.8 to 6.2 will help prevent most nutritional disorders.

Literature Cited

Nau, J. 2021. Ball redbook,19th ed. Ball Publishing, W. Chicago, IL.

Whipker, B.E., H. Landis, K. Hicks, W.G. Owen, and I. McCall. 2019. Expanding leaf tissue nutrient sufficiency standards for 74 floriculture species. Acta Hort 1266:173–180.

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, <u>or less.</u>
- Can split applications.

Hydrated Lime

- Mix 1 pound in 3 to 5 gallons of <u>WARM</u> 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.
- <u>*Provides 933 ppm K.*</u>
- <u>Leach heavily</u> the following day with a complete fertilizer to reduce substrate EC and restore nutrient balance.
- Rates <u>greater than</u> 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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