e-GRO Nutritional Monitoring




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Nutritional Monitoring Series

Coleus

(Plectranthus scutellarioides)

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Coleus propagated from seed or vegetative cuttings require medium fertility levels between 150 to 200 ppm N. Optimal substrate pH values for coleus range from 5.8 to 6.2. Substrate pH values above 6.5 inhibit Fe availability and induce interveinal chlorosis of the recently matured leaves. Low substrate electrical

Figure 1. Substrate pH above 6.5 or over irrigation can inhibit iron (Fe) uptake causing newly developed coleus *(Plectranthus scutellarioides)* leaves to become Fe-deficient and exhibit interveinal chlorosis (yellowing) as seen in the leaves above.

Coleus

Target Nutrition Parameters

pH Category III:
5.5 to 6.2

Fertility Category:
Medium
150 to 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. A top view of a coleus *(Plectranthus scutellarioides)* plant exhibiting extensive interveinal chlorosis (yellowing) on the newly expanding and growing leaves. Photo by: Brian Whipker.

conductivity levels will result in stunted plant growth, lower leaf chlorosis (yellow), and leaf loss.

Fertility Management of Coleus

Coleus propagated from seed or vegetative cuttings should be grown with a pH range of 5.8 to 6.2. This is the preferred optimal pH range. Coleus are tolerant of a wider range of 5.5 to 6.5 without exhibiting nutritional disorders. Above pH 6.5, iron (Fe) can become limiting and leads to interveinal chlorosis of the younger growth. High substrate pH above 6.5 can inhibit Fe uptake causing newly expanding leaves to develop interveinal chlorosis (Figs. 1 and 2). Corrective procedures for high substrate pH should begin within the range of 6.3 to 6.5.

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. Tissue nutrient levels found in healthy, newly expanded leaves of coleus are listed in Table 1. Monitoring substrate pH and nutrient status will enable growers to avoid pH induced nutritional disorders.

For seed propagated coleus, beginning at Stage 2 (cotyledon emergence), initiate 2 to 3 weekly applications of 50 to 75 ppm N delivered from a 14-0-14 fertilizer. During Stage 3 (true leaf development), increase fertility to 100-150 ppm N weekly, alternating

Figure 3. Providing insufficient fertility [low electrical conductivity (EC)] during coleus *(Plectranthus scutellarioides)* production can result in stunted plant growth. Comparison of insufficient (left plant per image) and sufficient (right plant per image) fertility. Photo by: W. Garrett Owen.

between 20-10-20 and 14-0-14 (Nau, 2011). At Stage 4 (toning; hardening off), a single application of 100-150 ppm N delivered from a 14-0-14 fertilizer is recommended (Nau, 2011).

For coleus propagated from vegetative cuttings, apply 50 to 75 ppm N from 20-10-20 once root initials are visible. Increase the rate from 100 ppm when root initials have developed on over 50% of the plants to 200 ppm N by day 14 of rooting. Alternate between a high nitrate-nitrogen type fertilizer such as 15-0-15 and high ammoniacal-nitrate 20-10-20.

After coleus plugs or liners are transplanted, providing medium fertility of 150 to 200 ppm N is recommend during vegetative growth phase (Nau, 2011). Fertilize at every other irrigation with 150 to 200 ppm N delivered from 20-10-20, alternating with 14-0-14. Higher rates of 200 to 300 ppm N may be required for older, vigorous vegetatively propagated cultivars.

Insufficient fertility levels (low EC) will result in stunted growth (Fig. 3) and lower leaf pale coloration and chlorosis (yellow; Fig. 4). Leaf loss also occurs with advanced symptomology (Fig. 5).

High EC can cause stunted plant growth and lower leaf necrosis (Fig. 6). Routinely check substrate EC and maintain below 0.9, 2.0, or 3.0 mS/cm, based on the 1:2 Extraction, SME, or PourThru methods, respectively.

Summary

Providing coleus with a moderate level of fertility ranging from 150 to 200 ppm N and maintaining a substrate pH of 5.8 to 6.2 will prevent most nutritional disorders from occurring.

Literature Cited

Bryson, G.M. and H.A. Mills. 2015. Plant analysis handbook IV. Micro Macro Publishing, Athens, GA.

Nau, J. 2011. Ball Redbook,18th ed. Ball Publishing, W. Chicago, IL.

Table 1. Leaf tissue nutrient sufficiency range recommended for coleus *(Plectranthus scutellarioides)*.

Element		Reference Coleus[1]
Nitrogen (N)	(%)	2.95-3.88
Phosphorus (P)		1.05-1.26
Potassium (K)		3.66-4.74
Calcium (Ca)		1.48-1.65
Magnesium (Mg)		1.27-1.48
Sulfur (S)		0.76-1.01
Iron (Fe)	(ppm)	49-79
Manganese (Mn)		312-352
Zinc (Zn)		35-48
Copper (Cu)		10-13
Boron (B)		29-32
Molybdenum (Mo)		-

[1] Source: Bryson and Mills (2015)

Figure 4. Providing insufficient fertility [low electrical conductivity (EC)] during coleus *(Plectranthus scutellarioides)* production can result in lower leaf pale coloration and chlorosis (yellowing). Plant at left was provided sufficient fertilizer and the one on the right nitrogen was withheld. Photo by: Brian Whipker.

Figure 5. Insufficient fertility [low electrical conductivity (EC)] during coleus *(Plectranthus scutellarioides)* production can cause lower leaves to drop. Photo by: Brian Whipker.

Figure 6. Excessive fertility [high electrical conductivity (EC)] during coleus *(Plectranthus scutellarioides)* production can cause stunted growth, lower leaves to necrosis, and salt accumulation as seen in the white crusting at the substrate surface. Photo by: Brian Whipker.

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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