e-GRO Nutritional Monitoring

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Nutritional Monitoring Series

Mini-Pot Rose

(*Rosa hybrida*)

American Floral Endowment

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Mini-potted roses require medium fertility levels between 150 to 200 ppm N. Optimal substrate pH values for mini-potted roses range from 5.8 to 6.2. The most common nutritional disorder occurs when substrate pH values drift above 6.5 inhibiting Fe availability and inducing interveinal chlorosis (yellowing) of the upper foliage.

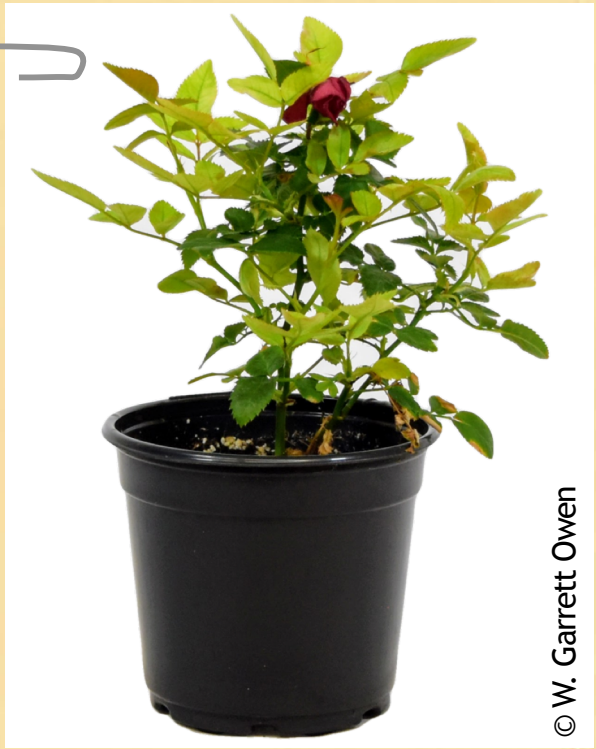

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Figure 1. High substrate pH above 6.5 can inhibit iron (Fe) uptake causing newly developed leaves of mini-potted rose (*Rosa hybrida*) to become Fe-deficient and exhibit chlorosis (yellowing). Photos by W. Garrett Owen.

Target Nutrition Parameters

pH Category III:
5.8 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. High substrate pH above 6.5 can inhibit iron (Fe) uptake causing newly developed leaves of mini-potted rose (*Rosa hybrida*) to become Fe-deficient and exhibit interveinal chlorosis (yellowing). Photos by W. Garrett Owen.

Figure 3. High substrate pH above 6.5 can inhibit iron (Fe) uptake causing newly developed leaves of mini-potted rose (*Rosa hybrida*) to become Fe-deficient and over time, can intensify where leaves become bright yellow or almost bleached (white). Photos by W. Garrett Owen.

Fertility Management of Mini-Potted Rose

Mini-potted roses should be grown with a 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. Tissue nutrient levels found in healthy, newly expanded leaves of mini-potted roses are listed in Table 1. Monitoring substrate pH and nutrient status will enable growers to avoid pH induced nutritional disorders.

High substrate pH above 6.5 can inhibit iron (Fe) uptake causing newly developed leaves to become Fe-deficient and exhibit chlorosis (yellowing; Fig. 1) and interveinal chlorosis (Fig. 2). If plants become severely Fe-deficient, interveinal chlorosis intensifies and leaves become white (Fig. 3). Corrective procedures for high substrate pH should begin within the range of 6.2 to 6.4. Pemberton et al. (1997) indicated a weekly liquid application of Fe-chelate and magnesium at 5 and 10 ppm, respectively, can be used to ensure green foliage color. Low substrate pH below 5.8 can result in stunted plant growth and delayed flowering (Fig. 4).

Mini-potted roses require medium fertility levels between 150 to 200 ppm N delivered from a well-balanced fertilizer providing calcium nitrate [$Ca(NO_3)_2$]. Common fertility regimes consist of a two-feed program: clear water alternating with a constant liquid fertilization and reducing fertility upon finishing or supplementing constant liquid fertilization with a topical application of a balanced slow- or controlled-release fertilizer (Pemberton et al., 1997). Furthermore, providing supplemental micronutrients into the constant liquid fertilization program will ensure proper growth of mini-potted roses.

Insufficient fertility [low electrical conductivity (EC)] during mini-potted rose production

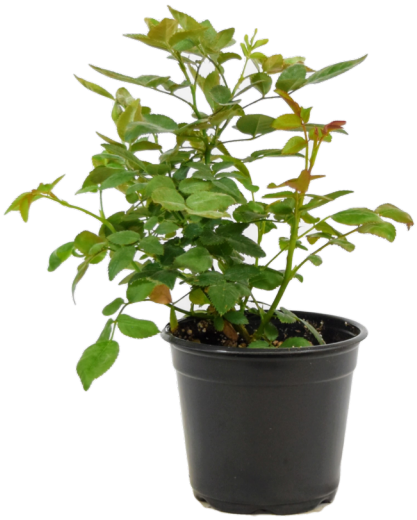

Figure 4. Low substrate pH below 5.8 during mini-potted rose (*Rosa hybrida*) can result in stunted plant growth and delayed flowering. Photos by W. Garrett Owen.

Figure 5. Providing insufficient fertility [low electrical conductivity (EC)] during mini-potted rose (*Rosa hybrida*) production can result in lower leaf chlorosis (yellow). Photo by W. Garrett Owen.

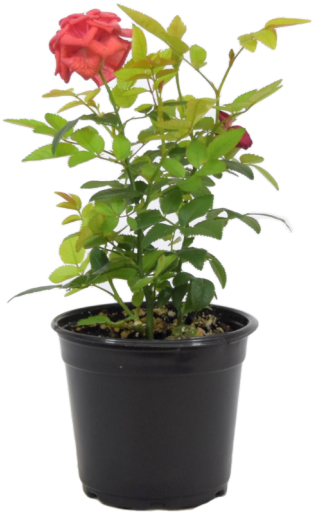

Figure 6. Providing insufficient fertility [low electrical conductivity (EC)] during mini-potted rose (*Rosa hybrida*) production can result in stunted plant growth. Photo by W. Garrett Owen.

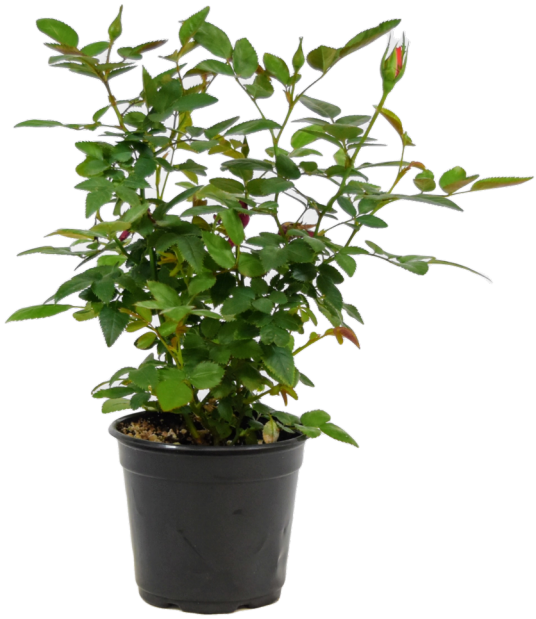

Figure 7. Providing excessive fertility [high electrical conductivity (EC)] during mini-potted rose (*Rosa hybrida*) production can result in in excessive vegetative growth. Photos by W. Garrett Owen.

can result in lower leaf chlorosis (yellowing; Fig. 5), uneven flowering (Dole and Wilkins, 2005), and stunted plant growth (Fig. 6). Substrate EC levels should not fall below 0.6, 1.3, or 2.0 mS/cm, based on the 1:2 Extraction, SME, or PourThru methods, respectively.

Providing excessive fertility [high electrical conductivity (EC)] during mini-potted rose production can result in in excessive vegetative growth (Fig. 7). 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, thereby alleviating the potential for inducing-high EC lower leaf necrosis (death).

Summary
Providing mini-potted roses 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

Dole, J.M. and H.F. Wilkins. 2005. Floriculture: Principles and species. 2nd ed. Pearson Education, Inc., Upper Saddle River, NJ.

Jeong, K.Y., B. Whipker, I. McCall, C.C. Gunter, and J. Frantz. 2011. Characterization of Nutrient Disorders of Pot Rose 'Karina Parade'. Acta Hort. 891:125–134.

Pemberton, H.B., J.W. Kelly, and J. Ferare. 1997. Rose, p. 112–121. In: M.L. Gaston, S.A. Carver, C.A. Irwin, and R.A. Larson (eds.). Tips on growing specialty potted crops. Ohio Florist Association, Columbus, O.H.

Table 1. Leaf tissue nutrient analysis for mini-pot rose (*Rosa hybrida* 'Karina Parade') grown under nutrient sufficient and deficient conditions to determine critical tissue nutrient levels.

Element		Reference Mini-pot Rose [1]	Critical tissue nutrient [1]
Nitrogen (N)	(%)	3.69	>1.59
Phosphorus (P)		0.34	0.10
Potassium (K)		2.88	1.36
Calcium (Ca)		1.25	0.20
Magnesium (Mg)		0.19	0.10
Sulfur (S)		0.26	0.22
Iron (Fe)	(ppm)	110.26	65.18
Manganese (Mn)		106.32	7.13
Zinc (Zn)		8.58	5.89
Copper (Cu)		1.07	<0.56
Boron (B)		71.74	2.55
Molybdenum (Mo)		---	---

Source: [1] Jeong et al. (2011)

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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