e-GRO Nutritional Monitoring



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Nutritional Monitoring Series

Marigolds

(Tagetes erecta & T. patula)

Marigolds require a low to medium level of fertility at 100 to 200 ppm N. The optimal pH range is between 5.8 to 6.2. This will avoid low substrate pH induced iron (Fe) and manganese toxicities which occurs if the pH drifts lower than 5.5. Substrate pH values above 6.5 can also inhibit Fe availability.

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Figure 1. Lower leaves of a marigold exhibiting yellow and bronzing leaf coloration due to a low substrate pH. Photo by: Brian E. Whipker.

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Low to Medium
100 to 200 ppm N

EC Category A, B:
1:2 Extraction:
0.4 to 0.9 mS/cm

SME:
0.9 to 2.0 mS/cm

PourThru:
1.3 to 3.0 mS/cm

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Figure 2. Low substrate pH results in the lower leaves developing a bronzing coloration due to the accumulation of iron and manganese (toxicity). Photo by: Brian E. Whipker.

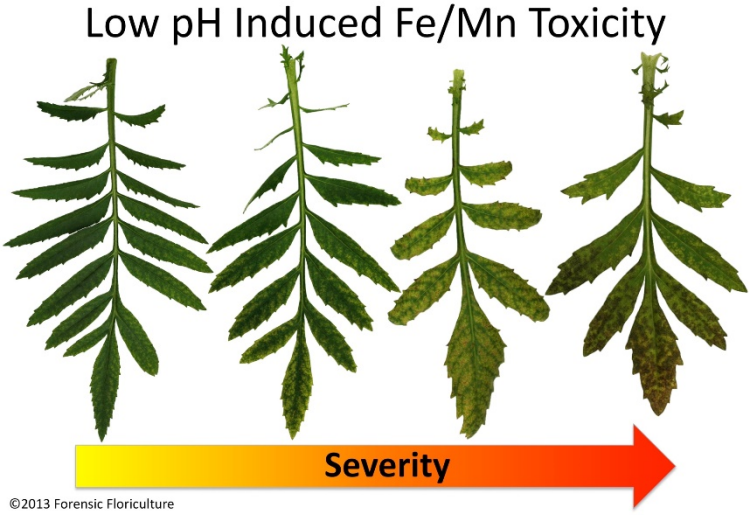

Figure 3. Progression of leaf symptoms due to a toxic accumulation of iron and manganese induced by a low substrate pH. Photo by: Brian E. Whipker.

Fertility Management of Marigolds

Marigolds are considered to require low to medium levels of fertility. Most growers supply between 100 to 200 ppm N. The lower end of the N rate is commonly used to help control excessive growth.

Marigolds should be grown with a pH range of 5.8 to 6.2. This range will help avoid two of the most common nutritional issues with the crop. The most disastrous is a low substrate pH induced iron (Fe) and manganese (Mn) toxicity that occurs if the pH drifts lower than 5.5 (Figs. 1 to 3). Lower leaves will develop a bronze speckled appearance. This is due to toxic levels of Fe, and sometimes Mn, accumulating in the tissue. Albano et al. (1996) found that lower leaf symptoms developed when leaf tissue Fe levels exceed 1000 ppm. One should denote that both Fe and Mn predominately accumulate in the lower foliage and then progress up the plant. It will take a few weeks for plants to grow out of this condition once the pH is corrected to the 5.8 to 6.2 range. Substrate pH values above 6.5 can also inhibit Fe availability. This is why the optimal substrate pH range is between 5.8 and 6.2 (Fig. 4). The range of 6.2 to 6.4 is the point in which corrective procedures should begin.

Both nitrogen (N) deficiency (Fig. 5) and phosphorus (P) deficiency can occur with marigolds. Nitrogen deficiency develops as an overall yellowing of the lower foliage or overall plant. This disorder occurs when the fertilization rate is too low. Note that water stress and tight spacing can also result in lower leaf yellowing. Phosphorus deficiency usually appears as a lower leaf purple coloration. It is most commonly observed when the growing temperatures are cool and low fertilization rates are used.

Summary

Therefore, providing low to moderate levels of fertility of 100 to 200 ppm N and providing a substrate pH range of 5.8 to 6.2 will prevent most nutritional disorders of marigolds.

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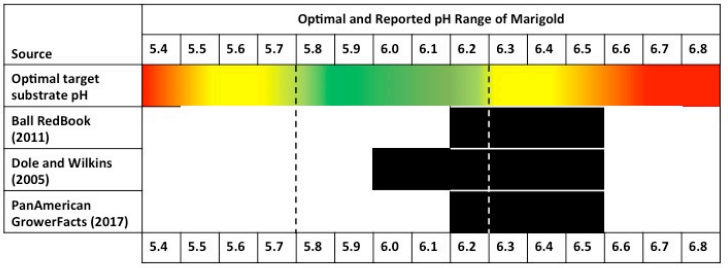

Figure 4. Reported and optimal pH range for marigolds based on literature indicating upper and lower pH limits inducing deficiencies and toxicities. Figure by: W. Garrett Owen.

Figure 5. Low fertilization rates will result in an overall pale yellow coloration due to insufficient nitrogen. Photo by: Brian E. 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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