e-GRO Nutritional Monitoring




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Nutritional Monitoring Series

Tomato Transplants

(Solanum lycopersicum)

American Floral Endowment
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Tomato transplants require low levels of fertilization, growing optimally with 100 to 150 ppm N continuously to maximize growth. Lower fertilization rates of 50 to 75 ppm N are often used to manage growth because few plant growth regulator options are available. This requires careful management of nutrients to avoid nutritionally stressing the plants and diminishing the yield potential of the transplants. Optimal substrate pH values are between 5.8 and 6.2. Tomatoes are susceptible to both low and high pH disorders, developing iron (Fe) and manganese (Mn) toxicity at low pH and Fe deficiency at high pH.

Figure 1. Low soluble salts [referred to as electrical conductivity (EC)] can result in lower leaf yellowing (chlorosis). Photo: Brian E. Whipker.

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Low
100 to 150 ppm N continuous. (Lower levels of 50 to 75 ppm can be used to manage growth, but nutrient and water stress should be avoided or the yield potential of the plants will be compromised.)

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 2. Low soluble salts [referred to as electrical conductivity (EC)] can result in lower leaf reddening, which denotes phosphorus is limited. Photo: Brian E. Whipker.

Figure 3. High soluble salts [referred to as electrical conductivity (EC)] due to an over-application fertilizer can lead to marginal leaf browning and death (necrosis). Photo: Brian E. Whipker.

Fertility Management of Tomato Transplants

Young tomato plants grown for transplants require low levels of fertility. The exact rates for nutrients depend on your market or finished plant quality. To maximize plant growth in the greenhouse and early yield performance in the field, fertilization rates should maintained between 100 to 150 ppm N (Weston and Zandstra, 1989). Lower levels of 50 to 75 ppm N are commonly used by growers to control growth. These levels can provide sufficient nutrition thereby avoiding nutritional deficiencies, yet not go too high to avoid excessive growth. One must also consider that plant age plays a part in yield potential. Early yield is diminished if the plants are held too long and become pot bound (≈>6 weeks old). In addition, the use of water stress to control growth can also negatively impact early yield. Low soluble salts [referred to as electrical conductivity (EC)] can cause yellowing (chlorosis) (Fig. 1) or reddening (Fig. 2) on the lower foliage. Increasing the fertilization rate will overcome the situation. High substrate EC can lead to marginal chlorosis or browning (necrosis) of the lower leaves (Fig. 3). To lower substrate EC, apply clear water to leach excess salts.

Maintaining growth control of tomato transplants presents unique challenges. Sumagic (uniconazole) is registered for use as a plant growth regulator (PGR) for very young seedlings. Growers must read and follow the label instructions, especially when using this product for the first time. Sumagic is a very potent PGR, and excessive levels can result in plant stunting. Because of few height control options later in the production cycle of transplants, growers often rely upon a low phosphorus (P), low ammoniacal-nitrogen, and low urea strategy. Avoiding these three fertilizer sources will aid in controlling excessive stretch. Instead, growers should utilize a fertilizer source blended from calcium nitrate and potassium nitrate, such as a 15-0-15. Periodic

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applications of a low P containing fertilizer providing 5 ppm P will help avoid the development of a P deficiency.

Substrate pH should be maintained between 5.8 and 6.2. Lower or higher values beyond this range commonly lead to low or high pH induced nutritional disorders. High pH inhibits iron (Fe) uptake, causing interveinal chlorosis of the upper foliage (Fig. 4) and thus, plants are Fe deficient. Low pH causes excessive uptake of Fe and manganese (Mn), which leads to toxicity symptom development. Toxicity of Fe and Mn exhibits symptoms of a lower leaf purplish coloration with black spotting (Fig. 5). Monitoring substrate pH and periodic tissue sampling can help to determine if symptoms are due to high or low Fe and Mn leaf tissue concentrations. Iron deficiency can be remedied with an application of iron chelate, while Fe and Mn toxicity can be remedied by flowable lime application to adjust (raise) the pH. Sufficiency ranges for foliar tissue are presented in Table 1 (Bryson and Mills, 2014).

Figure 4. High substrate pH leads to interveinal yellowing (chlorosis) on the upper foliage. Photo: Paul Cockson

Figure 5. Low pH leads to iron (Fe) and manganese (Mn) toxicity, causing symptoms of dark brown to black spotting. Photo: Brian E. Whipker.

Summary

Maintaining low to moderate fertility at 50 to 150 ppm N and a pH of 5.8 to 6.5 should enable you to grow healthy tomato transplants while preventing low or high pH induced nutritional disorders.

Literature Cited

Bryson, G.M. and H.A. Mills. 2014. Plant analysis handbook IV. Micro-Macro Publishing, Inc., Athens, GA.

Weston, L.A. and B.H. Zandstra. 1989. Transplant age and N and P nutrition effects on growth and yield of tomatoes. HortScience 24(1):88-90.

Table 1. Recommended range of leaf tissue analysis for tomato (*Solanum lycopersicum*).

Element	Sufficiency range [1]
Nitrogen (%)	3.0 – 5.0
Phosphorus (%)	0.3 – 0.6
Potassium (%)	3.0 – 5.0
Calcium (%)	1.0 – 2.0
Magnesium (%)	0.3 – 0.5
Sulfur (%)	0.3 – 0.8
Iron (ppm)	40 – 100
Manganese (ppm)	40 – 100
Zinc (ppm)	25 – 40
Copper (ppm)	5 – 15
Boron (ppm)	20 – 40
Molybdenum (ppm)	0.2 – 0.6

[1] Source: Bryson et al. (2014) for indeterminate tomatoes in production fields at the 5-leaf stage of age. These values represent the most recently matured leaf and petiole tissue.

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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