e-GRO Nutritional Monitoring



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Nutritional Monitoring Series

Pepper, transplants

(Capsicum annuum)

American Floral Endowment
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Peppers grown for transplant require very low levels of fertilization at <100 ppm N. Lower fertilization rates are desirable to limit stretch and maintain compact growth. However, inducing nutrient stress with excessively low nutrition can delay production and limit yield potential. Optimal substrate pH values range from 5.8 to

Figure 1. High soluble salts [referred to as electrical conductivity (EC)] can cause excessive vegetative growth with large, drooping leaves on pepper (*Capsicum annuum*). Photo by: W. Garrett Owen.

Pepper, transplants

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Ultra Low
<100 ppm N

EC Category A:
1:2 Extraction:
0.2 to 0.3 mS/cm

SME:
0.4 to 0.6 mS/cm

PourThru:
0.6 to 0.9 mS/cm

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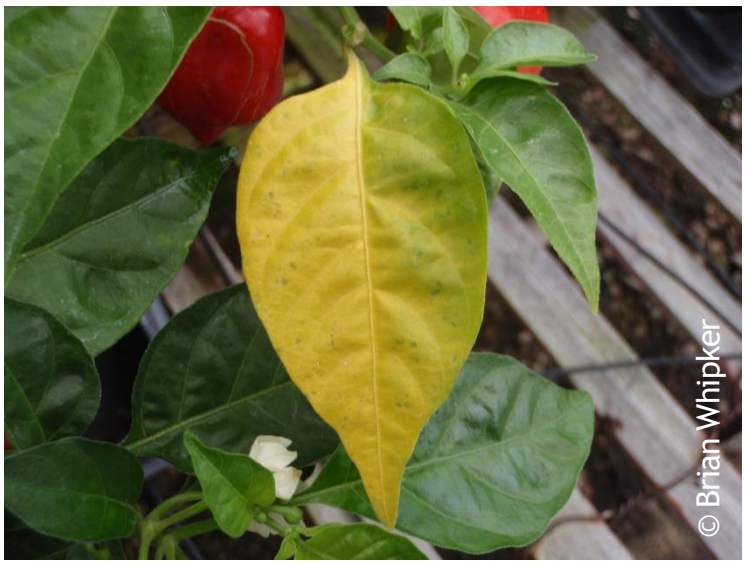

Figure 2. Low soluble salts [referred to as electrical conductivity (EC)] can cause lower leaf chlorosis (yellowing) on pepper (*Capsicum annuum*). Photo by: Brian Whipker.

Figure 3. High pH can limit iron (Fe) availability, leading to symptoms of interveinal chlorosis (yellowing) on the upper leaves of pepper (*Capsicum annuum*). Photo by: Brian Whipker.

6.2. Peppers are susceptible to both low and high substrate pH disorders. High pH inhibits iron (Fe) uptake, leading to symptoms of interveinal chlorosis (yellowing) on the upper leaves. Low pH causes toxic accumulation of Fe and manganese in the lower leaves, leading to black spotting.

Fertility Management of Pepper Transplants

Peppers grown for transplant require low levels of fertility. Fertilization should not begin until a few days after germination. Plants should be grown with < 100 ppm N using a complete fertilizer such as 20-10-20. Other recommendations suggest using high phosphorus (P) fertilizers such as 15-22-17 or 15-16-17. These fertilizers may cause excessive stem elongation, leading to tall, leggy plants. However, insufficient P can significantly limit growth and quality of young pepper plants, leading to a longer production period and lower potential yield.

Although we recommend growing pepper transplants with low fertility, it is important to maintain sufficient nutrition to avoid deficiency symptoms. Low soluble salts [referred to as electrical conductivity (EC)] can cause stunting and chlorosis (yellowing) on the lower foliage (Fig. 1). Raising the fertilizer rate or fertilizing more frequently will help to alleviate this problem. High salts cause excessive vegetative growth, leading to weak plants with large leaves (Fig. 2). With excessively high salts, the lower leaves may develop necrosis (death) and abscise from the plant. Too lower the substrate EC, apply clear water to leach excess salts.

Substrate pH is important to monitor, as peppers are susceptible to both high and low pH disorders. High substrate pH can inhibit iron (Fe) uptake and lead to Fe deficiency

symptoms of interveinal chlorosis (yellowing) of the upper foliage (Fig. 3). Symptoms may be confined to just the youngest leaves in early instances of high pH induced Fe deficiency (Fig. 4). Low substrate pH makes iron (Fe) and manganese (Mn) highly available for uptake. This leads to symptoms of Fe and Mn toxicity, which appears as black spotting on the lower leaves (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 raise the pH. Sufficiency ranges for pepper leaf tissue are presented in Table 1.

Figure 4. High pH can limit iron (Fe) availability, leading to symptoms of interveinal chlorosis (yellowing) on the upper leaves of pepper (*Capsicum annuum*). Photo by: Brian Whipker.

Figure 5. Low substrate pH causes symptoms of dark purple spotting on the lower leaves of peppers (*Capsicum annuum*). These spots are caused by a toxic accumulation of iron (Fe) and manganese (Mn). Photo by: Brian Whipker.

Summary

Maintaining very low fertility at 100 ppm N or less and a pH of 5.8 to 6.2 can help you to produce healthy pepper transplants without issues of high or low pH induces nutrient disorders.

Literature Cited

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Table 1. Recommended range of leaf tissue analysis for peppers (*Capsicum annuum*).

Element		Sufficiency Range [1]
Nitrogen (N)	(%)	4.0 – 5.0
Phosphorus (P)		0.3 – 0.5
Potassium (K)		5.0 – 6.0
Calcium (Ca)		0.9 – 1.5
Magnesium (Mg)		0.35 – 0.60
Sulfur (S)		0.30 – 0.60
Iron (Fe)	(ppm)	30 – 150
Manganese (Mn)		30 – 100
Zinc (Zn)		25 – 80
Copper (Cu)		5 – 10
Boron (B)		20 – 50
Molybdenum (Mo)		0.14 – 2.13

[1] Source: Bryson and Mills (2014). Samples taken in production fields prior to blossoming with the most recently matured leaf and petiole included.

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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