e-GRO Nutritional Monitoring

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Nutritional Monitoring Series

Parsley

(*Petroselinum crispum*)

Parsley requires low fertility levels between 100 and 150 ppm N. Insufficient fertility can cause chlorosis (yellow) on the lower foliage and stunted plant growth. Optimal substrate pH values from 5.8 to 6.2. Hight and low substrate pH values can induce foliage discoloration and stunt plant growth.

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Figure 1. Substrate pH below 5.8 during parsley (*Petroselinum crispum*) production results in stunted plant growth. Photo by: W. Garrett Owen.

Parsley

Target Nutrition Parameters

pH Category III:
5.8 to 6.2

Fertility Category:
Low to Medium
100 to 150 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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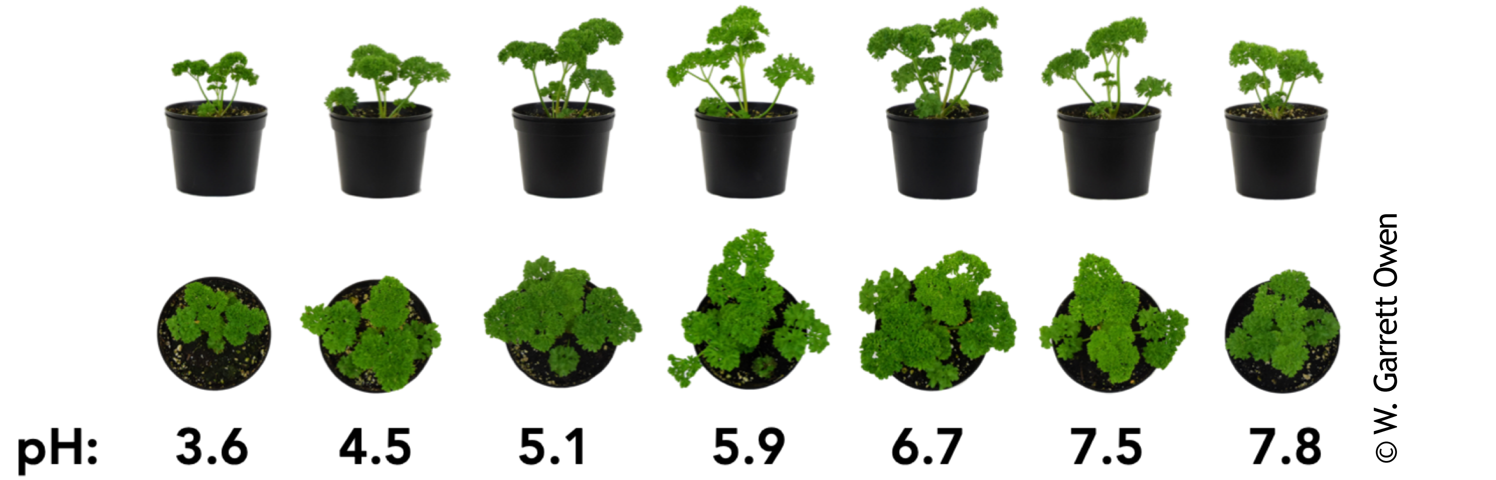

Figure 2. Substrate pH above 6.4 during parsley (*Petroselinum crispum*) production results in stunted plant growth. Photo by: W. Garrett Owen.

Fertility Management of Parsley

Parsley should be grown with a substrate 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. Recommended tissue nutrient levels found in healthy, newly expanded parsley leaves are provided in Table 1, which can help in diagnosing suspected nutrient disorders. Monitoring substrate pH and nutrient status will enable growers to avoid pH induced nutritional disorders.

Substrate pH below 5.8 results in stunted plant growth (Fig. 1). Corrective procedures for low substrate pH should begin around 5.6. Substrate pH below 5.4 to 5.6 will inhibit magnesium (Mg) uptake causing lower or older leaves to become Mg-deficient and exhibit interveinal chlorosis (yellowing). Monthly applications of supplemental Mg in the form of magnesium sulfate ($MgSO4$; Epsom salts) at a rate of 8 oz./100 gal. of water in areas with naturally occurring Mg in the water supply or 16 oz./100 gal. of water in areas lacking Mg in the irrigation water will prevent Mg deficiency and symptomology development.

High substrate pH above 6.2 can inhibit iron (Fe) uptake causing newly developed and recently matured leaves to become Fe-deficient or chlorotic. If Fe deficiency symptoms progress, chlorosis intensifies and leaves may become bleached. Stunted plant growth is the most often observed effect of high substrate pH (Fig. 2). Corrective procedures for high substrate pH should begin within the range of 6.2 to 6.4.

In propagation, once stems and cotyledons emerge (Stage 2), begin fertilizing parsley seedlings weekly with 50 to 75 ppm N delivered from 14-0-14. Maintain fertility levels throughout cotyledon expansion (Stage 3). As young seedlings mature (Stage 4), increase fertility to 100 to 150 ppm N.

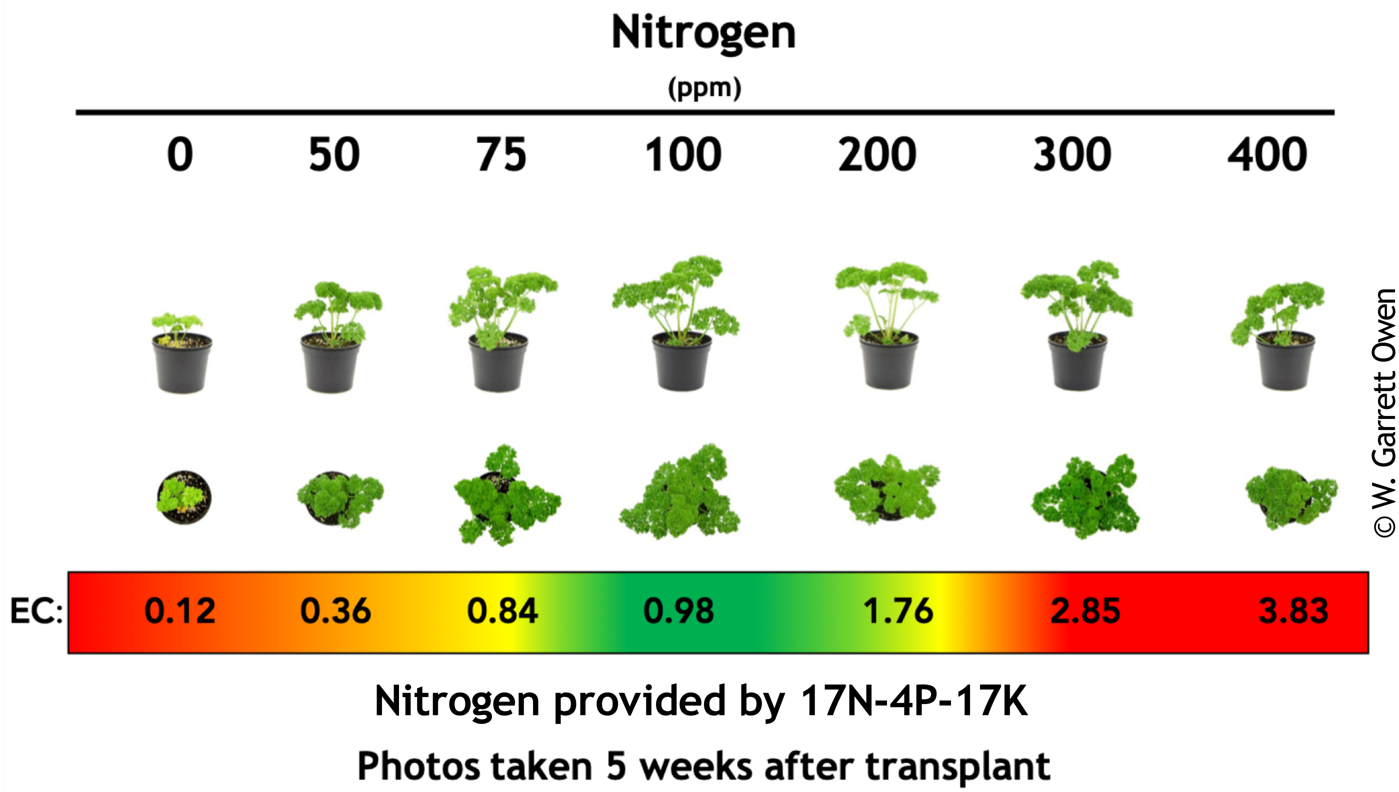

Figure 3. During parsley (*Petroselinum crispum*) production, maintain low to moderate fertility levels of 100 to 150 ppm N. Higher fertility levels such as 200 ppm N can be adequate, but monitor substrate EC. Photos by: W. Garrett Owen.

Figure 4. Providing insufficient fertility [low electrical conductivity (EC)] during parsley (*Petroselinum crispum*) production can result in chlorosis (yellowing) and stunted plant growth. Photo by: W. Garrett Owen.

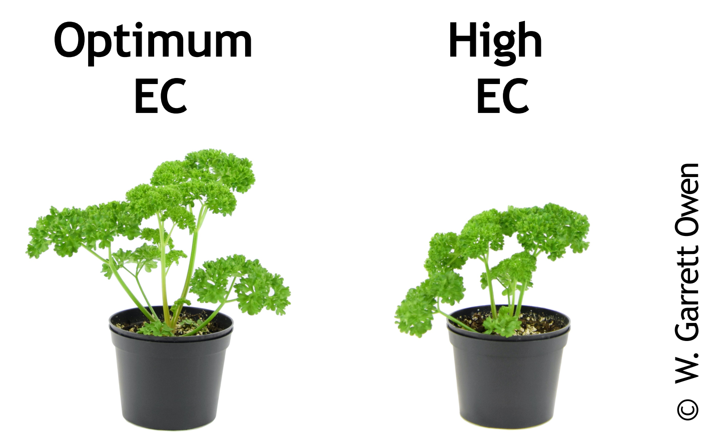

Figure 5. Overfertilization [high electrical conductivity (EC)] during parsley (*Petroselinum crispum*) production can result in stunted plant growth. Photo by: W. Garrett Owen.

After parsley plugs are transplanted into the final container, continue providing and maintaining a low to medium level of fertility at 100 to 150 ppm N (Fig. 3). A higher fertility rate of 200 ppm N can be adequate, but it is recommended to monitor substrate EC to ensure fertilizer salts do not accumulate and become detrimental to plants. Insufficient fertility levels (low EC) will result in lower leaf chlorosis and stunted plant growth (Fig. 4). Overfertilization (high EC) results in lower leaf necrosis (death) and stunted plant growth (Fig. 5). If EC values become excessive, leach the substrate with clear irrigation water twice before providing fertility. It is best to monitor the crop to avoid excessive EC values than to waste fertilizer by leaching it from the pots.

Summary
Providing low to medium fertility of 100 to 150 ppm N and maintaining a pH of 5.8 to 6.2 will help prevent most nutritional disorders.

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

Table 1. Recommended foliar nutrient concentrations for cilantro (*Coriandrum sativum*).

Element		Recommended Range [1]
Nitrogen (N)	(%)	4.00 – 6.00
Phosphorus (P)		0.42 – 0.85
Potassium (K)		3.80 – 5.00
Calcium (Ca)		0.85 – 1.25
Magnesium (Mg)		0.40 – 0.75
Sulfur (S)		0.22 – 0.35
Iron (Fe)	(ppm)	55 – 95
Manganese (Mn)		46 – 80
Zinc (Zn)		40 – 70
Copper (Cu)		5 - 15
Boron (B)		25 – 45
Molybdenum (Mo)		0.40 – 1.00

Source: [1] Bryson and Mills (2015)

Photographs as part of sponsored research by:
Metro Detroit Flower Growers Association
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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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