e-GRO Nutritional Monitoring



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Nutritional Monitoring Series

Celosia

(Celosia argentea)

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Celosia, also referred to as plumed celosia or plume cockscomb, have a low to medium fertilizer requirement of 100 to 200 ppm N. Optimal substrate pH values range from 5.8 to 6.2. Celosia can develop both low and high substrate pH disorders. High pH inhibits

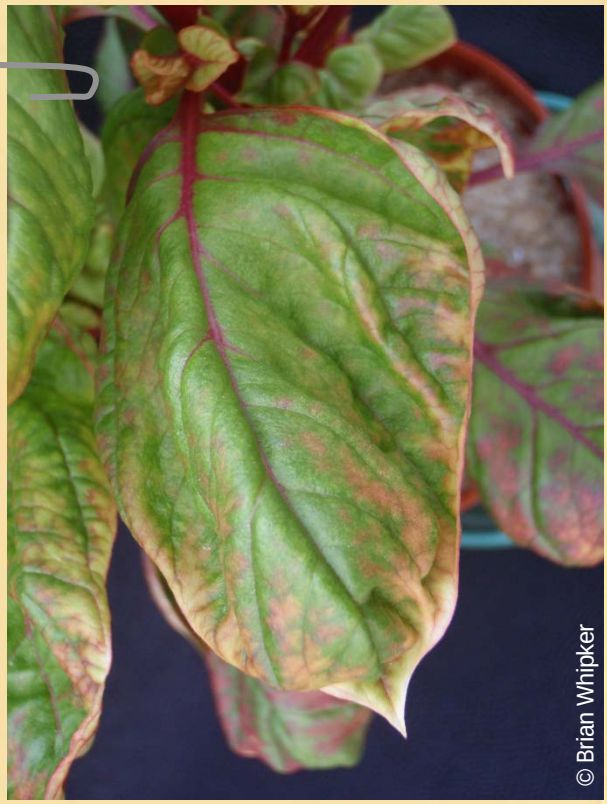

Figure 1. High soluble salts [referred to as electrical conductivity (EC)] result in marginal necrosis (death) on the lower leaves of celosia (*Celosia argentea*). Photo by: Brian Whipker.

Celosia

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:
0.9 to 3.0 mS/cm

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Figure 2. Low soluble salts [referred to as electrical conductivity (EC)] causes stunting, a pale green coloration, and chlorosis (yellowing) of the lower leaves in celosia (*Celosia argentea*). Photo by: Josh Henry.

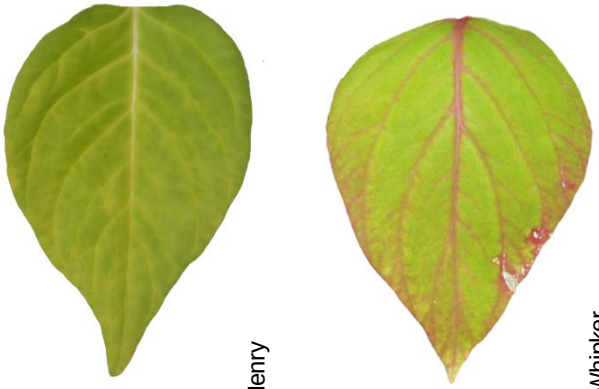

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Figure 3. Low soluble salts [referred to as electrical conductivity (EC)] causes chlorosis (yellowing; left) of the lower leaves in celosia (*Celosia argentea*) which may also have a red coloration (right). Photo by: Josh Henry (left) and Brian Whipker (right).

iron (Fe) uptake, leading to symptoms of interveinal chlorosis (yellowing) on the upper leaves. Low pH results in toxic accumulation of Fe and manganese in the lower leaves, leading to black spotting.

Fertility Management of Celosia

Celosia require low to medium levels of fertility. Celosia are seed propagated and during germination, the substrate should have low soluble salts [referred to as electrical conductivity (EC)]. Begin fertilization using 50 to 75 ppm N after the cotyledons have fully expanded. Use a low phosphorus (P) fertilizer such as 14-0-14 or 13-2-13 (Nau, 2011). After roughly one week, increase fertility to 100 to 150 ppm N. Use a low P fertilizer such as 13-2-13 or alternate between a high P and zero P fertilizer such as 20-10-20 and 14-0-14 (Nau, 2011).

Once transplanted, celosia should be fertilized with a low to medium level of fertility between 100 to 200 ppm N. If fertilizing at the low end of this range, apply fertilizer at every irrigation. If fertilizing at the high end of this range, alternate between 20-10-20 and 15-0-15, leaching excess salts with clear water at every other irrigation (Nau, 2011).

Celosia are particularly sensitive to high EC, which can cause necrosis (browning) on the lower foliage (Fig.1). Prevent buildup of excess salts by leaching with clear water as needed. Low substrate EC causes stunting and a pale green or chlorotic (yellow) appearance that first develops on the lower foliage (Fig. 2). Some cultivars exhibit a prominent red pigmentation in the leaves and stems that becomes more pronounced due

to low EC. This red coloration is also reported to occur in response to N, P, and magnesium (Mg) deficiencies (Gibson et al., 2007). However, not all cultivars express red pigmentation, especially those with yellow flowers (Fig. 3).

Substrate pH should be maintained between 5.8 and 6.2. Values below this range result in iron (Fe) and manganese (Mn) to become highly available for uptake and can cause Fe and/or Mn toxicity. Symptoms of low pH induced Fe and Mn toxicity appear as splotchy black pattern on the lower leaves (Fig. 4), primarily between the veins (Fig. 5). High substrate pH initially causes plants to develop a lighter green coloration compared to plants grown under optimal conditions, and plants may be larger with a greater number of leaves (Fig. 6). High pH will eventually result in symptoms of interveinal chlorosis on the upper foliage (Fig. 7).

Table 1 lists recommended nutrient ranges for celosia, along with critical nutrient levels at which point deficiency symptoms will be observed (Gibson et al., 2007). These values can help in diagnosing suspected nutrient disorders. Conduct routine foliar analyses to ensure nutrients are within the recommended ranges.

Summary

Maintaining medium fertility at 100 to 200 ppm N and a pH of 5.8 to 6.2 can help you to produce healthy celosia without pH or soluble salt related nutrient disorders.

Figure 4. Low substrate pH causes toxic iron (Fe) and manganese (Mn) accumulation and symptoms of black splotches on the lower leaves of celosia (*Celosia argentea*). Photo by: Josh Henry.

Figure 5. Low substrate pH results in toxic iron (Fe) and manganese (Mn) accumulation and symptoms of black splotches on the lower leaves of celosia (*Celosia argentea*). Photo by: Josh Henry.

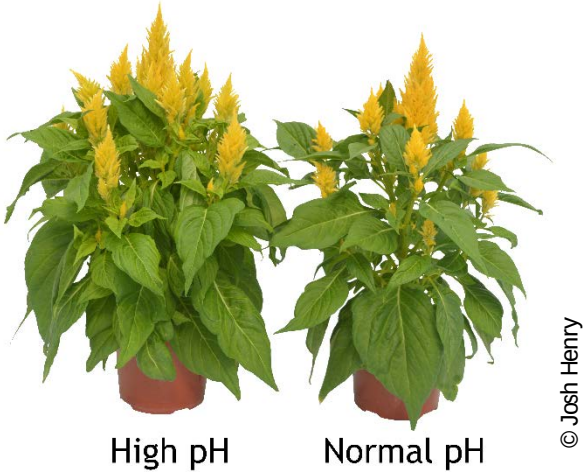

Figure 6. High substrate pH results in lighter colored foliage and greater vegetative growth in celosia (*Celosia argentea*). Photo by: Josh Henry.

Literature Cited

Gibson, J.L., D.S. Pitchay, A.L. Williams-Rhodes, B.E. Whipker, P.V. Nelson, and J.M. Dole. 2007. Nutrient deficiencies in bedding plants. Ball Pub., Batavia, IL. p. 79–90.

Nau, J. 2011. Ball redbook volume 2: Crop production. 18th ed. Ball Pub., West Chicago, IL. p. 249–250.

Figure 7. High substrate pH results in interveinal chlorosis (yellowing) on the upper leaves of celosia (*Celosia argentea*). Photo by: Josh Henry.

Table 1. Recommended range of leaf tissue analysis for celosia (*Celosia argentea*).

Element		Recommended Range [1]	Critical Minimum Level [1]
Nitrogen (N)	(%)	5.19 – 5.72	3.71
Phosphorus (P)		0.31 – 0.69	0.09
Potassium (K)		4.53 – 9.54	4.81
Calcium (Ca)		2.45 – 2.79	0.64
Magnesium (Mg)		0.77 – 0.84	0.11
Sulfur (S)		0.19 – 0.75	0.17
Iron (Fe)	(ppm)	72.7 – 130.0	54.9
Manganese (Mn)		258.3 – 545.7	13.7
Zinc (Zn)		26.5 – 175.0	7.6
Copper (Cu)		8.1 – 18.0	1.8
Boron (B)		28.4 – 53.0	8.9

[1] Source: Gibson et al. (2007).

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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