e-GRO Alert



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Micronutrient Madness: Basil

Lower leaf necrosis can occur as a result of excessive micronutrient applications. To confirm the diagnosis of a toxic condition, a tissue test is necessary.

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Basil is a relatively easy plant to grow with a low fertilization requirement of 100 to 150 ppm nitrogen (N) or in hydroponic culture with an electrical conductivity level of 0.5 to 1.5 mS/cm. It grows well within a pH range of 5.8 to 6.2 (Owen et al., 2018). Typically, basil experiences N deficiency as the most common nutritional issue. Iron (Fe) deficiency may also arise but is often associated with overwatering, root rot, or elevated substrate pH.

Figure 1. The initial symptoms of micronutrient excess on basil. (Photo: Patrick Veazie)

While micronutrients such as boron (B), copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn) are essential elements, they are required in smaller quantities compared to macronutrients such as N, phosphorus (P), and potassium (K). Excessive application of micronutrients can lead to toxicities.

In this particular case, the grower provided micronutrients at a rate six times higher than normal, resulting in lower leaf

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chlorosis and subsequent necrosis (Figs. 1-4). A leaf tissue nutrient test confirmed the diagnosis (Table 1). Boron levels were excessively high at 289 ppm, four times the upper sufficiency limit. Elevated concentrations of 354 ppm Fe (above the 200 ppm Fe upper limit), 390 ppm Mn (above the 150 ppm Mn upper limit), 107 ppm Zn, and 21.5 ppm Cu were also observed. Our research studies at NC State University over the past 20 years have consistently demonstrated that lower leaf necrosis is a common symptom when any of the micronutrients are supplied excessively. There are no distinguishing characteristics that identify a specific micronutrient causing the burn; therefore, submitting a tissue sample to a diagnostic lab is necessary.

The results of this situation support the diagnosis of micronutrient toxicity based on the visual symptoms and confirmation through leaf tissue nutrient analysis. Precision is crucial when measuring micronutrients since only a small quantity is required, and even a slight excess can result in micronutrient toxicity.

Additional Resources:

e-GRO Nutrient Monitoring: 1.14 Basil. 2018. W. Garrett Owen, Paul Cockson, Josh Henry, Brian Whipker, and Christopher Currey provides pH and fertility guidelines for basil.

Bryson, G.M. H.A. Mills, D.N. Sasseville, J.B. Jones, and A.V. Barker. 2014. Plant analysis handbook III. Micro-Macro Publ., Athens, GA.

Figure 2. Lower leaf chlorosis and necrosis of basil when excessive micronutrients were applied. (Photo: Brian Whipker)

Figure 3. Lower leaf waffle effect with excessive micronutrient applications. (Photo: Brian Whipker)

Figure 4. View of lower leaf chlorosis and necrosis progression of basil when excessive micronutrients were applied. (Photo: Patrick Veazie)

Table 1. Leaf tissue nutrient concentration in basil that had excessive micronutrients supplied.

Element	Unit Reported	Sufficient Range[1]	Sample Concentrations[2]
Nitrogen (N)	%	4.00 to 6.00	2.56 L
Phosphorus (P)	%	0.62 to 1.00	0.75 H
Potassium (K)	%	1.55 to 2.05	5.47 E
Calcium (Ca)	%	1.25 to 2.00	1.70 H
Magnesium (Mg)	%	0.60 to 1.00	0.88 H
Sulfur (S)	%	0.20 to 0.60	0.32 S
Boron (B)	ppm	25 to 60	**289 E**
Copper (Cu)	ppm	5 to 10	**21.5 H**
Iron (Fe)	ppm	75 to 200	**354 H**
Manganese (Mn)	ppm	30 to 150	**390 H**
Zinc (Zn)	ppm	30 to 70	**107 H**

[1] The Source: Bryson et al. (2014) for basil grown in production fields. These values are from the most recently mature leaves of new growth.
[2] The Interpretation Indexes from the North Carolina Department of Agriculture Agronomy Lab for each element are reported at D = deficient, L = low, S = sufficient, H = high, and E = excessive.

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