e-GRO Alert
Volume 5, Number 32 June 2016

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Nitrogen Deficiency:
Don't Let Bronze Foliage Fool You!

Don't be confused when diagnosing nitrogen deficiency on bronze foliage. Instead of the normal light green to yellow coloration, bronze foliage plants develop more of an orange to pink coloration, which can be mistaken as a phosphorus deficiency.

It is that time of year when gardens are being planted and growers are finishing a wide variety of vegetables and herbs in the greenhouse. On a grower visit in North Carolina, a bench of herbs displayed symptoms of chlorosis on the lower leaves. This overall yellowing of the lower leaves was very characteristic of nitrogen deficiency and generally low fertility (low EC).

There were a number of dill (*Amethrum graveoleus*) (Figure 1) and fennel (*Foeniculum vulgare*) (Figure 2) plants blocked together that all were showing similar patterns of yellowing, with the exception of one group. This group was made up of bronze fennel plants, which have a naturally bronze appearance to their leaves. Rather than the yellowing that was observed on the green leaf variety, the chlorosis appeared as various shades of orange or pink on the lower leaves (Figure 3).

This orange or pink coloration stood out, and would have been more difficult to recognize, had the green leaf varieties not been right next to them. The pink shades could easily have been

Figure 1. Dill showing nitrogen deficiency symptoms of overall chlorosis and necrosis of the lower leaves. Photo copyright by Josh Henry

misinterpreted as the stereotypical reddening that often results from a phosphorus deficiency (Figure 4).

All of these herbs were displaying a wide array of symptoms, ranging from just slightly chlorotic to completely necrotic. The progression of these symptoms is illustrated for the green fennel in Figure 5, and the bronze fennel in Figure 6.

To determine the cause of these symptoms, a quick PourThru test was done to check the pH and EC for the dill, green fennel, and bronze fennel. The dill had a pH of 6.4 and an EC of only 0.4 mS/cm, while the green and bronze fennel had pH ranging from 5.0 to 5.3 and EC of 0.14 mS/cm. Recommended pH values for herb production range between 5.8 and 6.2, indicating that the pH of the fennel was low (Gibson et. al, 2000). Low substrate pH can interfere with plant uptake of important macro elements such as nitrogen. Additionally, EC recommendations range from 0.6 to 0.9 mS/cm when using the PourThru extraction method [corresponding values for other EC extraction methods: 1:2 (0.2-0.4 mS/cm) or SME (0.4-0.6 mS/cm)]. The values from these dill and fennel plants were far below this range, giving further evidence of generally low fertility.

Figure 2. Green leaf fennel showing nitrogen deficiency symptoms of overall chlorosis and necrosis of the lower leaves.
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Tissue samples were taken from the dill and bronze fennel plants and submitted to the North Carolina Department of Agriculture Soil Testing Lab. Once the results from these tests came in, it became quite apparent that the cause of these symptoms was in fact low fertility with especially deficient levels of nitrogen. Table 1 shows the results of the tissue analysis compared with normal ranges for dill plants obtained from the Plant Analysis Handbook IV. Although there were no reported ranges for fennel, the reported tissue values for dill were used for comparison as the two crops are closely related.

Monitoring and Corrective Procedures

This was an interesting case of a crop displaying unique symptoms due to its natural leaf coloration. This stresses

Figure 3. Bronze fennel showing nitrogen deficiency symptoms of overall chlorosis and necrosis of the lower leaves.
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the importance to not only monitor your crop for any visual symptoms, but also conduct pH and EC tests to determine crop fertility.

To help correct these symptoms of lower leaf chlorosis, the crop should be fertilized once at a rate of 150 to 200 ppm nitrogen. Gibson et. al (2000) recommend weekly rotations between 15-0-15 and 20-10-20 at 100 ppm N with a monthly application of Epsom salts applied at a rate of 1 to 2 pounds per 100 gallons of water.

References:

Bryson, G.M. and H.A. Mills. 2015. Plant Analysis Handbook IV. IV ed. Micro Macro Publishing, Athens, GA.

Gibson, J.L., B.E. Whipker, and R. Cloyd. 2000. Success with Container Production of Twelve Herb Species. North Carolina State University Horticulture Information Leaflet 509.

Figure 4. This pink chlorosis on a bronze fennel leaf could easily be mistaken for phosphorus deficiency symptoms, but is actually due to nitrogen deficiency.

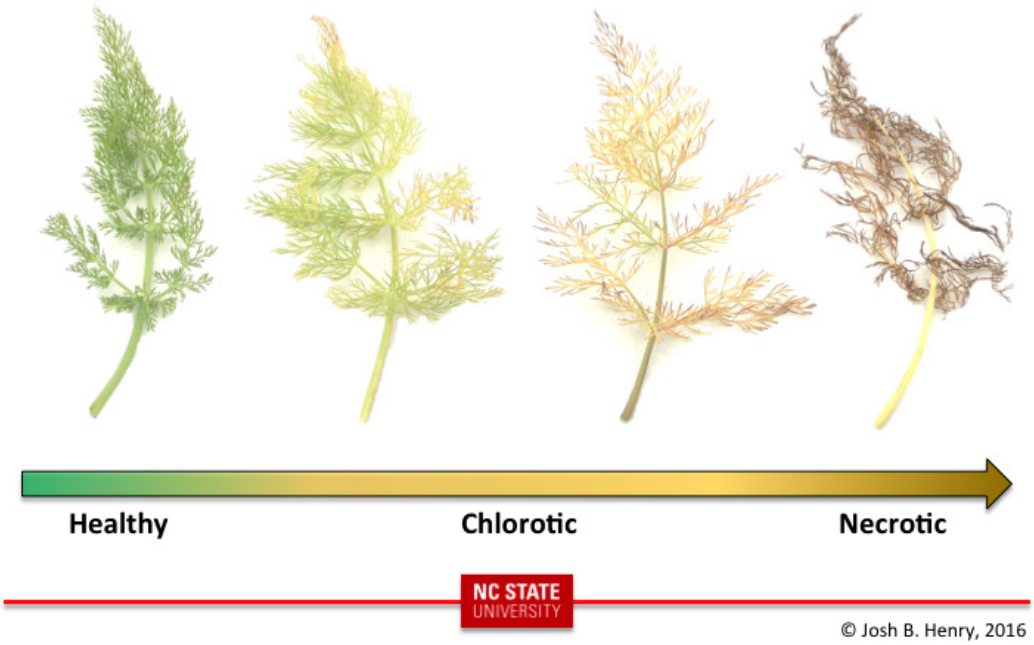

Figure 5. Progression of nitrogen deficiency symptoms: green leaf fennel.
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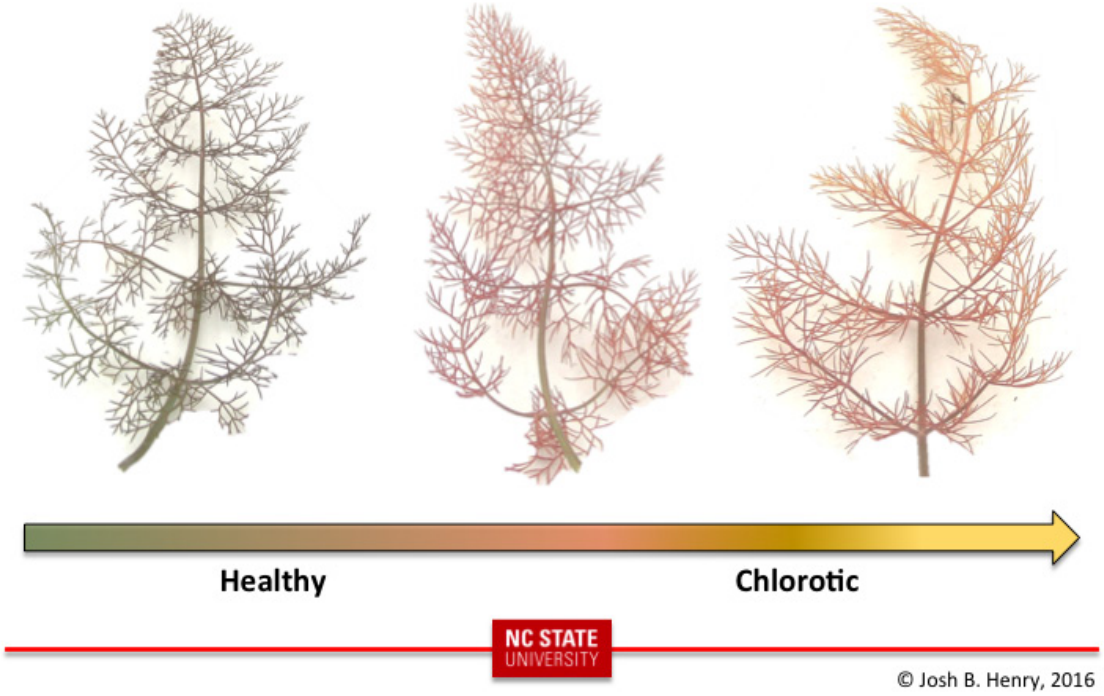

Figure 6. Progression of nitrogen deficiency symptoms: bronze leaf fennel.
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Element	Unit	Reported Values[1]	Chlorotic Dill Sample*	Chlorotic Bronze Fennel Sample*
N	%	4.5-5.5	**2.03**	**1.92**
P	%	0.31-0.45	**0.19**	**0.23**
K	%	3.50-5.00	**2.71**	3.74
Ca	%	1.25-2.20	**1.12**	1.26
Mg	%	0.25-0.40	0.65	0.52
S	%	0.30-0.40	**0.18**	**0.07**
Fe	ppm	60-300	98.3	**34.7**
Mn	ppm	50-250	**37.5**	**42.9**
B	ppm	25-55	27.8	36.5
Cu	ppm	5-15	**2.46**	**3.09**
Zn	ppm	25-100	31.2	31.9
Mo	ppm	0.4-1.0	-	-

[1] Dill tissue samples reported by G.M. Bryson and H.A. Mills in Plant Analysis Handbook IV. Sample is a survey range from 25 mature leaves and stems collected from the field.
*Red cells indicate values below healthy reported tissue values. Note nitrogen is far below the healthy range.

Table 1. Healthy Dill Tissue Values vs. Symptomatic Dill and Fennel Tissue Values