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Geranium:
Diagnosing Lower Leaf Reddish-Brown Spots

Low substrate pH induced micro-nutrient (iron/manganese) toxicity is discussed on geranium (Pelergonium x hortorum).

Zonal geraniums are a very common bedding plant produced in greenhouses around the U.S. When being grown in soilless medium, geraniums prefer a pH of 5.8 to 6.4. When the pH drops below this range, one may see some interesting symptoms develop. On a recent grower visit, these types of symptoms were observed on a large number of plants within a crop of geraniums (Fig. 1). The symptoms varied on the foliage, but could be seen initially as chlorotic spotting between the veins that later develops into interveinal chlorosis and eventually general necrosis. The progression of symptoms from a healthy leaf to a severely symptomatic leaf may be seen in Figure 2.

Figure 1. Geranium planter showing symptoms of chlorotic spotting, interveinal chlorosis, and general necrosis caused by low substrate pH. Photo by Joshua Henry

An initial sample was submitted by the grower when only a small portion of the crop was affected. The pH at this time was 5.3, which is lower than the optimal range for geraniums. After visiting the greenhouse, a pour-through test was also conducted to determine the pH and EC of a symptomatic plant. The pH was 4.3 and the electrical conductivity (EC) was 2.71. This pH is about 1.5 to 2.0 units lower than it should be. The EC is also higher than the accepted range of 1.5 to 2.5 mS/cm. [The bronzing of the lower foliage (Fig. 3) caused by low substrate pH can be mistaken as low fertility and the reaction often times is to increase the fertilization rate which leads to elevated

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EC readings. In addition, plant growth is slowed or stalled under low substrate pH conditions, which can lead to an accumulation of unutilized fertilizer salts in the substrate and a higher EC. Finally, all fertilizers are acidic when mixed, and an elevated EC will also create a more acidic substrate pH.]

Tissue samples were submitted for nutrient analysis after visiting the greenhouse. The results of tissue sample indicated that several micronutrient levels were high, with iron (Fe) and manganese (Mn) being excessively high. Boron levels were high at 43.3 ppm and so was zinc at 119 ppm. Recommended ranges obtained from Floriculture Principles and Species by Dole and Wilkins are 110-300 ppm for iron, and 270-325 ppm for manganese. The iron level from this sample was 2,850 ppm (>9 times higher than the upper limit of the recommended range), and manganese was at 1,860 ppm (>8 times higher than the upper limit of the recommended range).

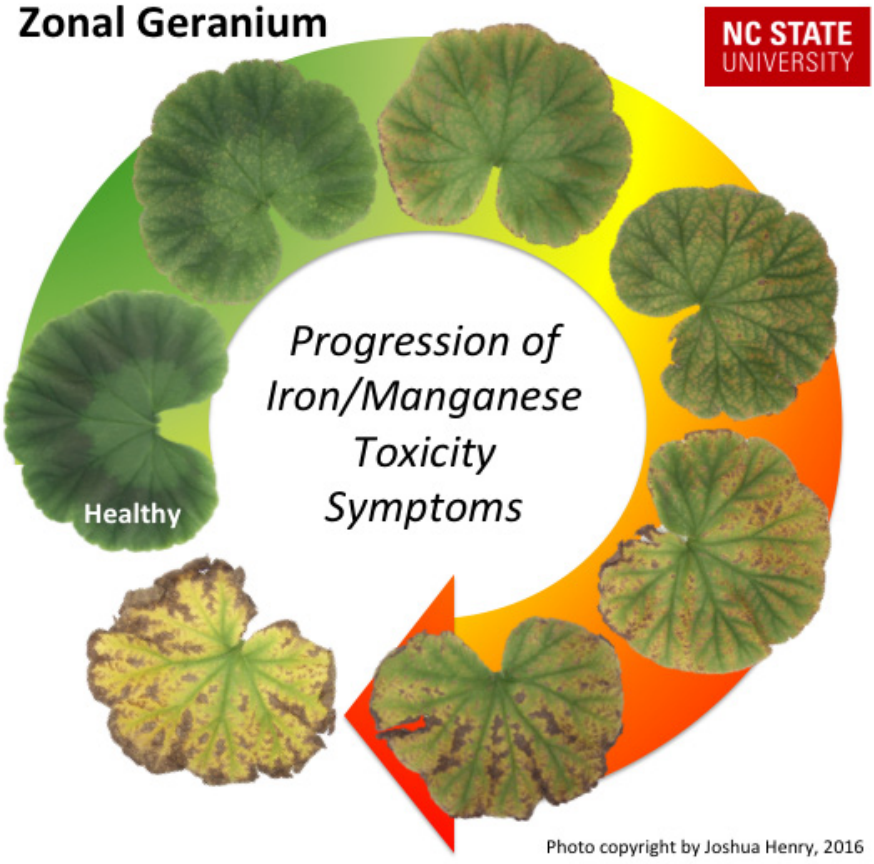

Figure 2. The progression of foliar symptoms of iron and manganese toxicity.

Figure 3. A bronzing and pale yellow leaf color also develops when symptoms of low substrate induced iron/manganed toxicity become more advanced. Photo by Brian Whipker

Iron and manganese toxicity commonly occurs on crops with low pH, leading to the symptoms observed on these geraniums. The pour-through test and tissue analysis results both confirm that these symptoms were due to the excessively low pH.

Corrective Procedures

When iron and manganese toxicity becomes a problem, raising the pH above 6.0 is best for seed geranium. 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

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one option. Typically a rate of 2 quarts per 100 gallons of water will increase the substrate pH by roughly 0.5 pH units. Two quarts can be used through the injector. Additional applications can be made if needed. Potassium bicarbonate can also be applied. The 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 and cause a spike in the substrate EC. So the following day a leaching irrigation with clear water is required to restore the nutrient balance (the ratio of K:Ca:Mg) and lower the EC level. As always, remember to recheck your substrate pH to determine if reapplications are needed.

Flowable Lime

Use 1 to 2 quarts per 100 gallons of water.

Rinse foliage.

Avoid damage to your injector by using rates of 2 qts per 100 gal of water, or less

Can split applications

Hydrated Lime

Mix 1# in 3 to 5 gal of WARM water. Mix twice. Let settle. Decant liquid and apply thru injector at 1:15.

Caustic (rinse foliage ASAP and avoid skin contact)

Potassium Bicarbonate ($KHCO_3$)

Use 2 # per 100 gal of water

Rinse foliage ASAP

Provides 933 ppm K

Leach heavily the following day with a complete fertilizer to reduce EC levels and restore nutrient balance.

Rates greater than 2 # per 100 gal of water can cause phytotoxicity!

Photo by Brian Whipker

References

Dole, J.M. and H.F. Wilkins. 2005. Floriculture: Principles and Species. 2nd ed. Prentice-Hall inc.

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