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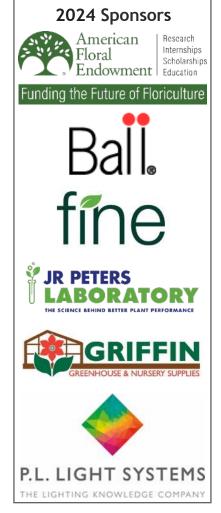
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# Maintaining Manganese: Pronounced Veination of Young Geranium Leaves

Summer hold-over plants offer the opportunity to view unique symptomology that rarely appears when plants are continually fertilized. Extensive veination of the young leaves is an unique characteristic of manganese deficiency in geraniums.



Figure 1. Pronounced "netted" veination occurs when manganese is limited. (Photo: Brian Whipker)



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Over the past few years, we have induced nutritional disorders on several species. These controlled experiments have allowed us to view unique symptomology on plants. In greenhouse production, observing common problems on geraniums is fairly routine, such as low pH, high pH, nitrogen deficiency, and magnesium deficiency. Rarer to appear are some of the micronutrient deficiencies.

On a recent extension trip, we inspected some geranium plants with unique leaf symptomology. The young leaves had pronounced veination (Figs. 1-3). The small veins popped out. The more typical high pH-induced iron deficiency symptoms result in wider

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bands of chlorotic tissue between the green veins (Fig. 4). Because of our prior research work, we had a pretty good idea that we were observing a manganese (Mn) deficiency.

# **Confirmation of Diagnosis**

Confirming a Mn deficiency diagnosis with leaf tissue analysis is required for this rare event. We ran a leaf tissue analysis at the NCDA&CS lab and found Mn to be 30.5 ppm. This concentration is low according to the standards published in the Plant Analysis Handbook (normal range is 40 to 325 ppm).

# **Corrective Procedures**

Given that these white cultivar plants were being held and were destined for the compost in a week or so, it was not a major production problem. Most likely the fertilizer charge had run out and that was why deficiency symptoms appeared.

The easy fix would be to provide normal fertilization with micros to help increase the supply. In addition, making sure that the substrate pH was not too high would help.

If it was a major problem, manganese chelate would be an option to use. Please note: if the substrate pH was low (<5.5), a Mn application would most likely result in excess Mn uptake and iron/manganese toxicity symptoms developing on the lower leaves.

# Conclusion

Given enough time and the right conditions, even less common micronutrient deficiencies can appear on a crop. When symptoms appear, be sure to check the roots, and substrate pH, and submit a leaf tissue sample to help diagnose the situation and then plot correction steps.



Figure 2. Multiple leaves with manganese deficiency symptoms. (Photo: Brian Whipker)



Figure 3. Symptoms only occurred on a single white cultivar. (Photo: Brian Whipker)



Figure 4. In comparison, when high substrate induced iron (Fe) deficiency symptoms develop the main veins remain green while the interior tissue develops an overall chlorosis. (Photo: Brian Whipker)

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