MICRONUTRIENT DEPLETION*

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Recently I was told by a nurseryman that they had inadvertently left out Micromax from a batch of mix last growing season and the plants grew off fine. Based on this incident, he was seeking my advice before stopping the addition of micronutrients entirely in order to save money. My advice was to continue to add 1.5 pounds of Micromax micronutrients per cubic yard of mix. The pennies saved would cost him dearly down the road. It is important to understand what happened to the plants that received no Micromax and why adding micronutrients is important to continued good plant growth.

Micronutrients are appropriately named in that the amount needed by the plant relative to nitrogen, phosphorus, potassium, calcium, magnesium and sulfur is indeed quite small or micro in proportion. But, the role the micronutrients play is critical to continued good plant growth.

When I began my research into the complex of growing plants in containers at the University of Florida in 1968, micronutrient deficiencies were rampant. Some of the most dramatic plant responses to treatments I have ever observed occurred during that time. For several studies I obtained liners from commercial nurseries and placed them in experiments where varying levels and proportions of micronutrients had been added. The plants would go from having off colored and sometimes chlorotic leaves and dull leaf surfaces to lots of bud breaks and vibrant new growth. I recall thinking "Wow, I have found the answer". But, when cuttings were taken from the best plants in the study and rooted and placed again into the same or similar nutritional treatment as before, plant response was good, but was not as dramatic as with the parents and in some cases chlorosis or other micronutrient deficiency symptoms occurred. What happened?

Plant growth is most affected by the most deficient element or complex of deficient elements. Typically, the more severe the deficiency, the greater plant response when the deficient element is added. But with cuttings taken from those plants, deficiencies were less severe, so plant response was less dramatic. Also, it is important to realize that even with the plant response to the micronutrient elements added, the levels and proportions were far from being correct as would be revealed in later studies. In looking back at some of those early studies, it is likely that plants went from a deficiency of one micronutrient element to an excess, thus further complicating the sorting out of cause and effect.

Another factor that came into play and added to the intrigue was the fact that on most occasions' cuttings taken from plants growing in the field were less responsive to micronutrient treatments compared to cuttings taken from plants growing in containers.
I began to wonder about the residual of micronutrient elements in plant tissue. In other words, if the levels and proportions of micronutrients in a good field soil provided certain concentrations in leaves of cuttings, how long would it take for those micronutrient levels to decline to the point of causing deficiency symptoms?

To study this, I chose copper as the element to vary. I took cuttings from Chinese holly plants growing in a good field soil with suitable micronutrient levels, rooted those cuttings in a propagation mix with no micronutrients added. The liners were planted into a container growth medium with no copper added, but the other micronutrients were added (the best levels I knew at the time). After one growing season the plants looked normal in every way so cuttings were taken from those plants, rooted in a propagation mix with no micronutrients added. The following growing season the liners were again planted onto a container growth medium with no copper added but the other micronutrients present. At the end of the second growing season the plants still looked normal. Again, cuttings were taken from those plants and rooted and the procedure repeated. Only near the end of the third growing season could symptoms typical of copper deficiency be detected (exceptionally dark green leaves, reduced leaf size, death of terminal growth and a proliferation of buds on lower stems).

To continue this study, cuttings were taken from the plants now showing copper deficiency and rooted. Cuttings were also taken from the original parent plants growing in field soil and rooted. The following growing season, both sources of liners were planted into containers where the growth medium had the best complex of all micronutrient elements known at the time.

Liners from the copper deficient parents produced dramatic new growth free of deficiency symptoms. By the end of the growing season, plants from the severely deficient parents were similar in size, branching and overall quality as plants from parents grown in field soil and that showed no copper deficiency. Cuttings were taken from plants with both treatments, rooted and grown in containers with all micronutrients added the following year. There were no detectable differences in plant response or plant quality the second year.

The take home message from this series of experiments is that copper deficiency does not occur abruptly. It was not until near the end of the third production cycle with no copper added to the growth medium of the parent or the offspring's when tissue levels in the plant were diluted to the point where copper deficiency symptoms were evident. Copper levels in recently matured leaves were monitored during the studies. Interestingly, tissue analysis varied more between individual plants with the same treatment compared to between plants with or without copper added to the growth medium and provided little useful information. Based on this and other work, I am not a fan of tissue analysis for diagnosing micronutrient deficiencies, with a few exceptions.

Micronutrient depletion also appears to play a role in river birch. River birch trees grown in field soils rarely show the stunting and abnormal leaf development referred to as mouse ear disease. This is a problem unique to containers and dates only from about 1980. Container growth media components such as pine bark, peat, sand or other materials typically contain virtually no nickel. Micronutrient fertilizers do not include nickel and would have only miniscule amounts as impurities. With refinements in slow release fertilizers, single or triple superphosphate which contained significant nickel are rarely added to container growth media anymore. Applications of nickel sulfate have been shown to eliminate the problem. It appears that mouse ear disease of river birch results from the near complete exclusion of nickel as an impurity in fertilizer components and dilution of nickel in plant tissue.

Micronutrient deficiencies are rare where nurseries consistently add 1.5 pounds of Micromax micronutrients per cubic yard of a growth medium and have good quality irrigation water. Adding 1.5 pounds of Micromax per cubic yard is very inexpensive insurance against tissue micronutrient depletion.