Iron Deficiency in Greenhouse Crops

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Reports of iron deficiency in greenhouse crops are increasing, due in part to the surge in popularity of new vegetatively-produced crops that have lower soil pH requirements. In addition, some growers have made adjustments in their production practices that are inadvertently increasing the incidence of iron deficiency.

Figure 1. Iron deficiency symptoms (interveinal chlorosis in new foliage) in petunia grown at pH above 6.2. Photo by Rick Yates, Griffin

Iron deficiency appears as an interveinal chlorosis of the youngest foliage because iron is needed to make chlorophyll (green pigment), and new leaves can expand more quickly than iron can be taken up by plant roots (Fig 1). Untreated, the chlorosis progresses back from the growing tips to affect the older growth as well. Often the plant becomes severely stunted and over-watering follows, resulting in *Pythium* root rot.

Iron deficiency usually results from:

- An excessively high medium-pH (above pH 6.2 for sensitive species). Iron in fertilizer is more soluble in the medium at low pH, and low pH therefore increases iron availability for root uptake. *Diagnose with a soil-pH test. If you are not able to test soil pH on location, utilize the services of a reputable soil-testing lab.*

- Some plants are inefficient at taking up iron from the medium (termed the "Petunia Group" of iron-inefficient species) including Bacopa, Basil, Brachycome, Calibrachoa, Diascia, Nemesia, Pansy, Petunia, Scaevola, Snapdragon, and Vinca. *These plants, which quickly show iron deficiency symptoms, can be grown at a lower pH range (5.4-6.2) than other plants in order to increase iron solubility.*

Figure 2. Micronutrient deficiency symptoms in Calibrachoa caused by *Thielaviopsis* root disease. Photo by Rick Yates, Griffin

- Insufficient fertilizer. With a complete fertilizer blend containing micronutrients, fertigating at 300 ppm N will provide three times the iron level as 100 ppm N. For example, vegetatively-produced or "Wave" type petunias can show iron deficiency simply because they are not being fertilized at high enough levels to supply adequate iron. *Diagnose by checking the fertilizer injector is supplying the EC you intend, and supply sufficient fertilizer so that EC in the medium is maintained in the optimum range (e.g. 1.2-2.5 mS/cm using a saturated medium extract test for potted crops).*
- Poor or diseased root systems – if roots are not functioning effectively, they cannot supply adequate iron to the foliage. Figure 2 shows a calibrachoa with *Thielaviopsis* root rot exhibiting chlorosis on newly forming growing tips. *Diseased roots will often result in a patchy distribution of deficiency symptoms in the crop, with some plants in worse shape than others. Diagnose by inspecting roots. Correct disease or fungus gnat problems first using cultural and chemical approaches, and nutrition problems second.*

Well-deserved attention has been given recently to the problems geranium growers have experienced related to iron /manganese toxicity at low pH (below 6.0). Unfortunately, when growing a wide range of crops on the same irrigation system some pH conflicts can occur. Geranium growers have been adjusting their fertilizer programs in order to keep soil pH between 6.0 and 6.5. Although ideal for the "Geranium Group" of crops (seed and zonal geraniums, lisianthus, marigolds, New Guinea impatiens) which are prone to iron/manganese toxicity at low pH), this pH range is higher than the target range for the Petunia Group.

Here are some tips to grow plants with different nutrition requirements:

- Train your staff to recognize the likely problems with each group of plants - micronutrient deficiency for the Petunia Group, and toxicity for the Geranium Group.
- When growing a range of species in the same container (e.g. a combination basket or pots) or same fertilizer injector and medium, maintain pH 6.0 to 6.2.
- Before planting all types of combination baskets, avoid mixing the Petunia and Geranium Groups.
- If you have to have specific combinations that do not grow well together, then grow plants for combination baskets or pots in separate 4-inch pots, and combine in the final container 2 weeks before sale.
- Organize greenhouse zones so that plants within the same nutritional group can be managed with one injector or fertilizer tank.
- If you have the ability to run different fertilizers, use a more acidic-reaction fertilizer (i.e. more ammonium) for the Petunia Group, and a more basic-reaction (nitrate-based) fertilizer for the Geranium Group.
- If you have high alkalinity and can adjust acidification, acidify for the Petunia Group, and not for the Geranium Group.
- Some growers will incorporate more lime into media for the Geranium Group before planting to raise pH above 6.0, or apply flowable lime at 1:100 into the media as a standard practice before or immediately after planting.

- If you use one injector for everything, after planting test the pH and be prepared to apply flowable lime to the Geranium Group if medium-pH is below 6.0, or supplement iron for the Petunia Group if pH is above 6.2.
- Avoid low EC in the medium for the Petunia Group, and high EC for the Geranium Group.

The best way to avoid iron deficiency is to keep medium-pH in the acceptable range (5.4-6.2 for the Petunia Group, 6.0-6.6 for the Geranium group, and 6.0-6.2 is acceptable for all plants). If pH is excessively high, consider temporarily acidifying irrigation water down to pH 4.5 if alkalinity is >120 ppm $CaCO_3$, and you have the equipment to safely and effectively use acidification. If acid injection is not practical, try using a highly acidic fertilizer such as 21-7-7 or 9-45-15 for 1-2 weeks to see if pH is brought down to the acceptable range.

To directly cure iron deficiency symptoms, first send in a tissue sample to a laboratory to confirm that iron is the problem nutrient. This is important because deficiencies of other nutrients (e.g. manganese or zinc) look very similar, and their symptoms could actually become worse if you apply iron. Never apply iron drenches to the Geranium Group because you could inadvertently cause iron toxicity.

For other plants that show chlorosis and low iron in tissue, apply a soil drench of iron chelate (iron-DTPA, Sprint 330™ or iron-EDDHA, Sprint 138™) at 5 oz/100 gal (moderate rate for mild chlorosis). Severe chlorosis may require a second application at the 5 oz/100 gal rate 10-14 days after the first. Iron-EDDHA is more effective than iron-DTPA if pH is above 6.5, because iron-EDDHA is soluble across a wide pH range (Figure 3). Avoid foliar sprays or dry applications of iron to the soil, because phytotoxicity is likely. Immediately following a drench application, rinse excess iron off the leaves and flowers because concentrated iron can cause brown or black spots to form. Iron chelate is fast-acting with improvement starting as soon as a few days after treatment.

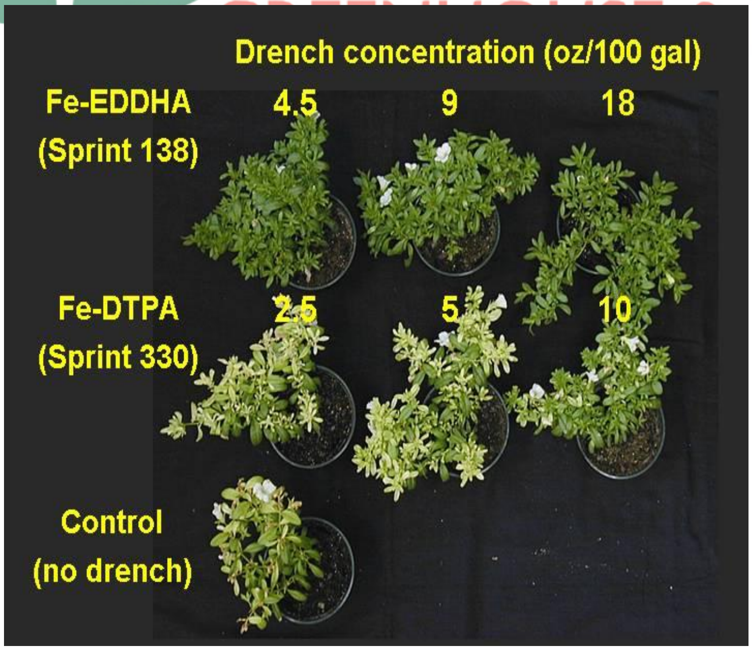

Figure 3. Effect of a single soil drench of either Iron-EDDHA or Iron-DTPA at three concentrations (corresponding to 20,40, or 80 ppm iron) and 100 ml (3.4 oz)/4 inch diameter pot. Control plants were drenched with deionized water. Drenches were applied 14 days after transplanting to Calibrachoa 'Million Bells Trailing White' rooted cuttings, grown in a peat/perlite medium at medium pH 7.0, and the photograph was taken 10 days after the drench. Photograph by Ron Wik, Univ of New Hampshire. Research was supported by the FIRST organization.