IRON DEFICIENCY OF CHRYSANTHEMUM RESULTING FROM OVER-STERILIZATION

Paul V. Nelson

This article is another in a series of nutritional topics which we are drawing from problems as we find them in North Carolina greenhouses. Since late summer the problem pictured in Fig. 1 has been encountered at four different greenhouse ranges. The diagnosis, iron (Fe) deficiency, and the cause, over-sterilization of the soil, were the same in each case.

SYMPTOMS: Iron deficiency symptoms occur in the young leaves at the top of the plant and on the lateral shoots. This stems from the fact that iron is a non-mobile nutrient, meaning that it cannot translocate from portions of the plant where it has accumulated previously to young leaves and stems where rapid growth expansion is creating a shortage. First, the young leaves take on a light green appearance. Shortly later, the cells between the vascular tissue (the veins) become yellow (chlorotic) while the cells over the vascular tissue remain light green. This condition is known as "interveinal chlorosis" and is the most typical symptom of Fe deficiency of plants in general.

CAUSES OF IRON DEFICIENCY: There are two common causes of Fe deficiency. The first is an alkaline, or high, soil pH. Under high pH conditions Fe becomes insoluble and thus unavailable to the plant. For each rise in pH of one unit; e.g., 5.0 to 6.0, the level of available Fe is reduced to one-tenth of the previous level. Temperate soils hold a large reserve of Fe, approximately 4% or 80,000 pounds per acre - 6" deep. Almost all of this is unavailable as witnessed by the dramatic recovery from Fe deficiency which can be obtained by the application of as little as 5 pounds of Fe in chelated form to the acre. The size of this disproportionately small fraction of available Fe is strongly controlled by the soil pH level. In general, pH values above 7.2 will result in the occurrence of Fe deficiency.

A second cause of Fe deficiency is the presence of a large quantity of available manganese (Mn) in the soil. This interferes with the movement of Fe to the parts of the plant where it is needed and also renders much of that Fe in the plant tissue non-functional. In the four greenhouse situations mentioned, an excessive amount of Mn was found in the soil and in the plant tissue. Mn, like Fe, exists in two forms in the soil, a large fraction of unavailable Mn and a smaller fraction of available Mn. Steam sterilization of soil causes a shift in Mn from the unavailable to the available form. When steam is left on for longer periods of time than is necessary there is the risk of developing a level of available Mn high enough to stimulate Fe deficiency. This was the case in the greenhouses mentioned.

DIAGNOSIS: A North Carolina soil report reading of 100+ for Mn and the appearance of Fe deficiency symptoms are cause to suspect Mn-induced Fe deficiency. The final diagnosis should come from foliar analysis. Normally tissue concentrations of 60-70 ppm for Fe and 30 ppm for Mn would be considered minimum critical levels. However, much of the Fe within the plant is inactive when the Mn content is high thus the minimum critical Fe level rises. The high Mn level alerts us to the need to reinterpret the Fe level in the tissue. In one situation this past fall a Mn level of 2300 ppm and Fe level of 150 ppm were measured in chrysanthemum foliage. In this case the Fe level was deficient and an application of Fe to the soil brought about recovery.

CORRECTION: This problem may be corrected by the soil application of Fe. Florists in North Carolina have had long lasting results from the use of Sequestrene 330 Fe Iron Chelate applied to the soil at the rate of 1 lb. per 1,000 sq. ft. It is better to avoid the problem in the first place by using a thermometer in the soil being sterilized. Thirty minutes after the soil reaches 180°F sterilization should be terminated.

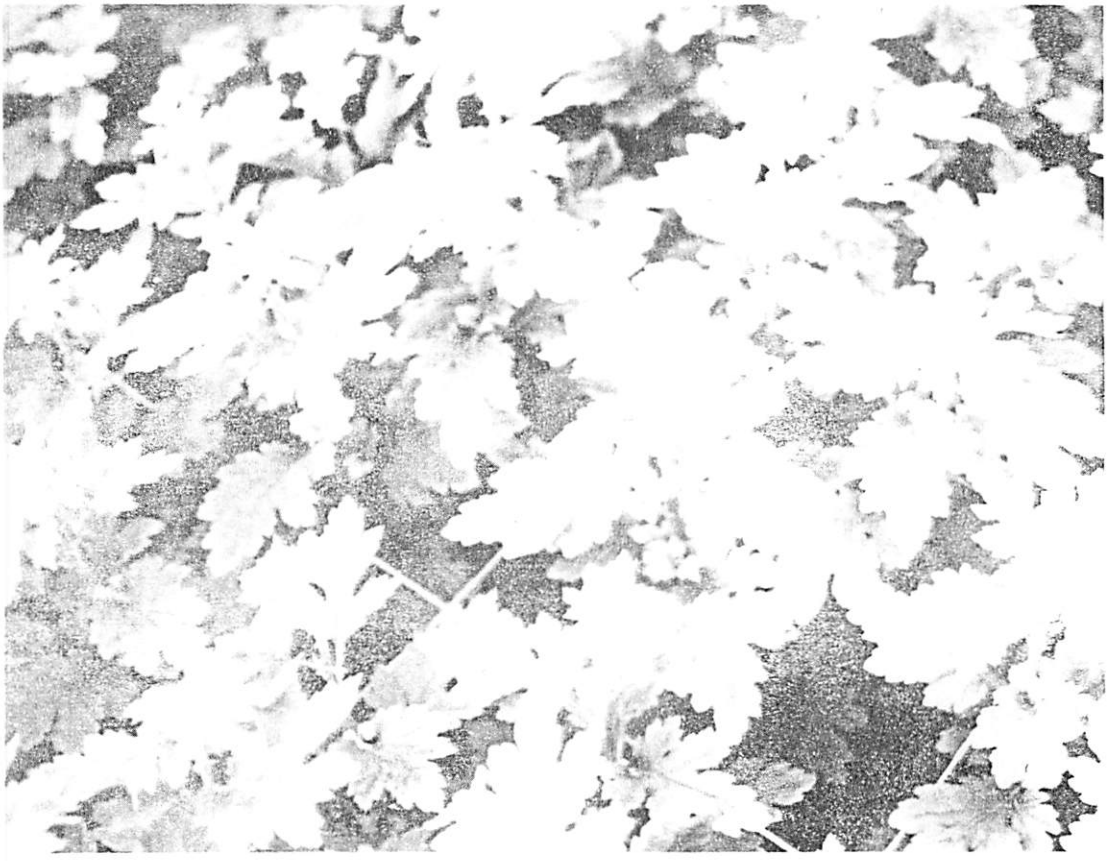

Figure 1. Fe deficiency in chrysanthemum plants brought on by the excessive release of Mn from soil as a result of the prolonged sterilization of soil by steam.