Testing Soils for Copper, Iron, Manganese, and Zinc

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Recognition that Cu, Fe, Mn, and Zn are essential for plant growth and that Cu, Fe, Mn, and Zn deficiencies occur in the field preceded the development of soil tests for the micronutrient cations. The essentiality of Fe for plant growth was proven in 1844 by Gris (Bonner & Galston, 1952) and that of Mn in 1905 by Bertrand (Stout, 1956). In 1914, Maze provided the evidence that Zn was needed by plants and, in 1928, Sommer and Lipman demonstrated the plant requirement for Cu (Stout, 1956). The criterion for essentiality was based on the inability of plants to complete their life cycles under conditions of insufficient Cu, Fe, Mn, or Zn.

After establishment of the essentiality of Cu, Fe, Mn, and Zn, it was a normal progression to evaluate whether lack of these elements caused abnormal plant growth on problem soils. These micronutrient deficiencies were first identified under field conditions in horticultural crops. Copper deficiency of citrus, or "dieback," and Mn deficiency of tomato (Lycopersicon esculentum Mill.) were identified in Florida by Grossenbacher (1916) and Skinner and Ruprecht (1930), respectively. Deficiencies of Fe (Thomas & Haas, 1928) and Zn (Chandler et al., 1932) were diagnosed in Californian citrus. Thereafter, these deficiencies were confirmed in agronomic crops under field conditions. Copper and Mn deficiencies of oat (Avena sativa L.) plants were confirmed in Wales (Davies & Jones, 1931) and Florida (Harris, 1947), respectively. A chlorotic condition of sorghum [Sorghum bicolor (L.) Moench], which limited grain yields on the Southern Great Plains, was diagnosed as Fe deficiency (Myers & Johnson, 1933). Barnette et al. (1936) reported that Zn application as ZnSO₄ increased corn (Zea mays L.) grain yield and that
