Physiological Aspects of Calcium, Magnesium, and Molybdenum Deficiencies in Plants

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Plants grown on acid soils often exhibit many physiological disorders. These disorders are usually related to the changes and chemical forms of mineral elements that occur in acid soils. The higher rainfall common to acid soils often leaches essential mineral elements from the soil and enhances toxic conditions by increasing solubilization and activity of such elements as Al and Mn.

Physiological disorders that often appear in plants grown on acid soils are Al and Mn toxicities and Ca, Mg, Mo, and P deficiencies. This chapter addresses the physiological effects of Ca, Mg, and Mo deficiencies in plants.

Recent literature has classified mineral element functions in plants according to their biochemical and physiological behaviors rather than according to their concentrations (macronutrients or micronutrients) in plant tissues (Clarkson & Hanson, 1980; Hughes, 1972; Mengel & Kirkby, 1982). With the use of these approaches, elements required for plant growth have been classified into four major groups: (i) elements that are covalently bonded into constituents or organic matter (C, H, O, N, and S); (ii) elements that occur as oxyanions or are esterified with native alcohol groups (P, B, and Si); (iii) elements that have nonspecific, osmotic, and ionic balance functions plus specific functions in enzyme conformation and catalysis, i.e., these elements maintain an ionic identity as free or reversibly bound ions as metal-protein complexes (K, Na, Mg, Ca, Mn, and Cl); and (iv) elements that form metalloproteins, are present as structural chelates, and participate in redox reactions or valency changes (Fe, Cu, Zn, Mo, and Mn in its function in the photosystem II pathway). From the physiological point of view, this classification better describes the functions of Ca, Mg, and Mo in plant processes.

1 Contribution of the U.S. Department of Agriculture, Agricultural Research Service, and the Department of Agronomy, University of Nebraska, Lincoln, as Paper no. 7159, Journal Series, Nebraska Agricultural Experiment Station.

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