20 Magnesium Nutrition for North Dakota Crops

20.1 Magnesium in plant nutrition

Soil magnesium (Mg^{2+}) originates from ferromagnesian minerals, including biotite and serpentine. It also originates from secondary clay minerals including smectites and illites, both of which are common to soils across North Dakota. Soils in North Dakota with salt levels greater than one (and EC >1), almost always contain some quantity of magnesium sulfate ($MgSO_4$). Plant-available Mg ions (MMg^{2+}) come from soluble forms in the soil, both exchangeable and non-exchangeable forms which exists in equilibrium with each other, and magnesium-bearing minerals. Non-exchangeable Mg^{2+} is limited in its release under dry soil conditions (as is K^+ and NH_4^+) particularly in smectitic clays; only being released when the soil is moist. Mg^{2+} does not result in soil flocculation like Ca; and, although compared to Ca it has a greater hydraulic radius, its role in soil dispersion is limited. In contrast to Ca, transport of Mg^{2+} within the plant is conducted by the phloem and as such, it is considered mobile and can be translocated from older tissues to younger tissues if deficiencies are present. The most well-known role Mg^{2+} plays in plants is as a main component of the chlorophyll molecule. Magnesium is also associated with phytic acid in grains, and provides a charge balance for organic acids including oxalic acid and citrate. Magnesium serves as a co-factor in virtually all energy-requiring functions, serving as a bridge between ATP/ADP and the enzyme catalyzing the reaction of a specific substrate. Another key reaction requiring Mg^{2+} is the activation of ribulose bisphosphate carboxylase. Light stimulates the importation of Mg^{2+} into the chloroplast in exchange for H+, which results in a favorable environment for the carboxylase reaction.

##Deficiencies of magnesium in North Dakota crops

There has been no documented Mg deficiency recorded in any crop grown in North Dakota. If deficiencies begin to appear, they will likely be related to soils with a low CEC, or that are highly kaolinitic such as the soil west of the Missouri River, that have recently had calcitic liming materials applied to combat acid soils. Application of KMag™, Potassium magnesium sulfate, or dolomitic limestone would quickly alleviate the deficiency.