

Macro and Micro Nutrients

The following article was written by Ed Lentz, Hancock County Extension and Jim Hoorman. Farmers often get sales pitches when it comes to plant nutrition. They generally are knowledgeable about the main nutrients, but they are encouraged to try new products to improve crop yields. A basic understanding of soil fertility is important for high crop production.

All crops require sixteen essential nutrients for proper growth and development, the specific amount of each nutrient depends upon the crop. The air or atmosphere provides carbon, hydrogen and oxygen. The rest must come from the soil and the amount available for a plant depends upon many factors such as the soil type, organic matter, pH, drainage, microbes, temperature, and rainfall. In the soil, nutrients are absorbed with water being pulled through the plant, diffusion exchange from a chemical gradient, and by roots intercepting the nutrient molecules.

Some nutrients are required in large amounts compared to other nutrients, which are often collectively called primary or macronutrients. Primary nutrients include nitrogen (N), phosphorus (P), or potassium (K). Nitrogen is used to form amino acids and proteins in the plant and most plants need 3-5.5% of their plant tissue biomass as N. Phosphorus is used in plants as the genetic backbone for DNA and for energy transfer. Plants generally need 0.2 to 0.5% of their plant tissue biomass as P. Potassium is used in the plant to provide plant turgor, to move sugars and starches, to increase photosynthetic production, and to activate enzymes and proteins. Increasing plant K increases protein content or N content. Optimal K levels are 2.5 to 4.0 percent in the whole plant tissue of corn and 4% in soybeans. In most cases the soil cannot provide enough primary nutrients at a critical time to optimize crop production so farmers add N-P-K fertilizer to improve grain yields. Providing for these three elements provide 85 to 90% of the typical crop yield.

Calcium, magnesium and sulfur are also needed in relatively large amounts but much less than N-P-K. These nutrients are collectively called secondary nutrients. Soils in northwestern Ohio formed from glacial activity and limestone bedrock high in calcium and magnesium, so our soils are naturally high in these nutrients. In addition, organic matter in our soils provides adequate levels of sulfur, which limits the need for fertilizers with secondary nutrients. However, sulfur may be lost from the soil much like nitrogen. Over the years most of sulfur came from impurities in other fertilizers and from atmospheric deposition (provided by the heavy industry and coal burning facilities to our West). These depositions have gradually decreased in recent years as improvements have been made in air quality. There is a concern that crops may not be able to obtain adequate levels of sulfur without supplementing with fertilizer.

Generally, calcium in plant tissues is in the 0.25 to 0.8 percent range and magnesium in the 0.15 to 0.6 percent range for corn and soybeans with small grains requiring slightly

higher levels. Calcium in plants is used in cation exchange and transport while magnesium is the critical core molecule for chlorophyll used in photosynthesis. Sulfur is tied to protein production and levels range from 0.2 to 0.8 for most crops depending upon the age of the plant. For most plant nutrients, the nutrient concentrations are higher in young plant tissue and during reproduction.

The remaining eight nutrients are required in very small amounts by plant tissue and are called micronutrients or trace elements. These plant nutrients are used in parts per million (ppm). The micronutrients include boron (20-100 ppm), copper (5 to 25 ppm), iron (40 to 300 ppm), manganese (25 to 160 ppm), zinc (20 to 80 ppm), molybdenum (0.2 to 2 ppm), nickel (1-10 ppm) and chlorine. Historically, our soils have adequate levels of these micronutrients and seldom will a farmer see a response by adding a micronutrient fertilizer unless a deficiency has been found.

Farmers have been looking at fertilizers as a way to get a few more bushels from their fields. Plant food companies have responded by heavily promoting micronutrients and secondary nutrients. Some of these products are being promoted on testimonials and not scientific research, so be careful of what you buy and know why and if you need a particular product. Information for this article was obtained from the Ohio Agronomy Guide and Iowa State University Extension "Plant Analysis and Micronutrients for Crops" bulletin.