

## NoroTec micronutrients.

**Intelligent state-of-the-art formulations in the service of the environment and growers.**

### **Nutrients Absorption: A Complex Process**

A quick review of how nutrients are absorbed shows that nutrient absorption is not a simple matter, and that it is important to be selective when choosing a nutrient supplement.

Many mineral forms are insoluble compounds which are not available to the plant for absorption until they are converted into free mineral ions. This occurs when they are exposed to the low pH of the soil. However, if acid output is low, the minerals may not be solubilized and thus cannot be absorbed. This is only the first of many obstacles that minerals encounter during the plant growth.

#### **Mineral uptake.**

Once released by the low pH of the soil, mineral ions pass into the roots. For a short distance, the pH remains low enough to keep the ions in free form so they can be bound to mucosal proteins for transport across cell membranes. This ionic transport mechanism is the first mineral absorption pathway and is accomplished by an energy-dependent process. Although some passive diffusion of free ions across cell membranes can take place, this is minimal and most ionic mineral absorption is by the active transport process.

Minerals that are not absorbed through the ionic absorption pathway continue to travel up where they can be absorbed by the second mineral absorption pathway which is a mineral peptide transport system. Here, the mineral ions binds (i.e. chelate) to amino acids that then carry the mineral across the membrane as an intact molecule. Unfortunately, mineral ions at this point are also exposed to a number of factors that can impede their ability to be absorbed.

Since minerals cannot remain ionized at more alkaline pH levels, they quickly form mineral compounds. If the minerals bind with oxalates (found in spinach and other foods) or phytates (common in many cereal grains), they form insoluble compounds that cannot be absorbed. If, however, the mineral binds with an appropriate amino acid carrier, thus forming a stable di- or tri-peptide chelate, it has a significant chance of being absorbed. Competition from other minerals for binding proteins and amino acids and the plants current mineral status are other contributing factors that determine how much of each mineral may be absorbed.

## **What Are Amino Acid Chelates?**

By definition, an amino acid chelate is formed when two or more separate portions of the same amino acid molecule form chemical bonds with the same atom of mineral (metal). One of these portions is the carboxyl group which forms an ionic bond, and the other reactive portion is the alpha-amino group which forms a coordinate covalent bond. By doing so, a stable five-membered ring is formed that now includes the mineral metal atom.

About two amino acid ligands are bound to the same metal atom, creating double-ringed molecules with a unique three-dimensional structure, and a molecular weight of less than 800 daltons. True amino acid chelates have a defined ratio ligand to mineral, which should be about 2:1. At this time, NoroTec owns the patents to produce these chelates in high purity.

## **Unique 3-Dimensional Structure.**

The unique three-dimensional structure of true amino acid chelates protects the mineral from unwanted interactions during plant growth. The low molecular weight of true amino acid chelates ensures that they are absorbed intact. In fact, true amino acid chelates behave very similar to dipeptides (a pair of two amino acids). As a result, these chelates tend to be absorbed more like a dipeptide rather than a free mineral, and intestinal dipeptide absorption is known to be very efficient.

True amino acid chelates are also well utilized within the plant, because they not only stay together during absorption and transport, but also release the mineral when and where needed to perform its specific functions in the plant.

The superior bioavailability of certain dipeptide-like amino acid chelates has been demonstrated in many studies. This is especially true for magnesium, iron, copper, zinc, and manganese.

## **Mineral Chelates Offer More Reliable Absorption.**

To eliminate much of the "hit or miss" nature of mineral absorption which affects most mineral forms, we utilize mineral amino acid chelates in many of our combination and individual mineral supplements. By chemically bonding minerals to an optimal amount of amino acids, the resulting fully chelated mineral compound is intact during growth and transport, resulting in superior bioavailability and tolerance.

The unique three-dimensional, dipeptide-like structure of our amino acid chelates protects the mineral from unwanted interactions during application so that it can be efficiently absorbed via active transport mechanisms. These chelates are less likely to bind to antagonistic components that can lower bioavailability, such as phytate binding to zinc.



They are also less likely to cause adverse interactions. And, amino acid chelates do not interfere with each other's absorption as do free, ionized minerals. Since mineral chelates are formulated to withstand exposure to acid, the sensitive membranes of the tissue are also more protected from irritation by the mineral.

Not all "chelates" found in supplements are equally effective, as many of the unique benefits of a true amino acid chelate can be lost when the compound is not properly made. Norotec owns the patents for production of high purity amino acid chelates.

### **True Mineral Amino Acid Chelates Offer Unique Benefits**

True amino acid chelates are emerging as state-of-the-art technology for delivering selected mineral and trace elements with maximum bioavailability, tolerability and safety. Unless properly made, full chelation of the metal and amino acid may not take place, resulting in loss of the overall benefits of a properly made mineral chelate.

Norotec is at the forefront of the research and development of amino acid chelates. For certain minerals, amino acid chelates are by far the most bioavailable and the safest mineral supplement sources now available. The efficacy of the Norotec formulations is backed by numerous official field trials over 12 years in comparison with other standard products on the market.

In "Norotec" amino acid chelates, minerals are chemically bonded to an optimal amount of amino acids. They stay together during digestion, and they stay together during absorption, resulting in superior bioavailability, tolerability, and safety.

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***Norotec AB***