NUTRIENT ELEMENT DESCRIPTIONS

Each of the elements essential for plant growth performs a distinct function in the metabolism process. Their fundamental properties will be described in the following paragraphs.

NITRATE
Nitrate Ammonium is found in both inorganic and organic forms in the plant, and combines with carbon, hydrogen, oxygen and sometimes sulfur to form amino acids, amino enzymes, nucleic acids, chlorophyll, alkaloids, and purine bases. Nitrogen rates high as a molecular weight protein in plant tissue. Deficiencies exhibit slow growing, weak and stunted plants with light green to yellow leaves. Quality and yield will be significantly reduced. Excess conditions will be dark green and succulent with breakdown of vascular tissue restricting water uptake. Stress resistance is drastically diminished.

SILICON
Silicon usually exists in solution as silicic acid and is absorbed in this form. It accumulates as hydrated amorphous silica most abundantly in walls of epidermal cells, but also in primary and secondary walls of other cells. It is largely available in soils and is found in water as well. Inadequate amounts of silicon can cause new leaves to be deformed and inhibit yields and fruit set.

POTASSIUM AND PHOSPHATE
Potassium is involved in maintaining the water status of the plant and the turgor pressure of it's cells and the opening and closing of the stomata. Potassium is required in the accumulation and translocation of carbohydrates. Lack of potassium will reduce yield and quality. Older leaves will be scorched on edges and the plant will become susceptible to disease and toxicity. Excesses will interfere with magnesium and calcium availability.

Phosphorus is a component of certain enzymes and proteins, adenosine triphosphate (ATP), ribonucleic acids (RNA), deoxyribonucleic acids (DNA) and phytin. ATP is involved in various energy transfer reactions, and RNA and DNA are components of genetic information. Deficiencies exhibit slow growing, weak and stunted plants with dark green or purple pigmentation in older leaves and stems. Excess will interfere with iron and zinc stability in solution.

CALCIUM - MAGNESIUM - SULFATE
These ions may be present in high levels in groundwater. It is important to consider these values when adding nutrient supplements.

Water Hardness is an indication of the calcium and magnesium content. Moderately hard water, 100 to 150 mg CaC03 is desirable for plant growth. If the water is very soft, less than 50 mg, you may need to provide supplemental calcium and magnesium.

Calcium plays an important role in maintaining cell integrity and membrane permeability. Deficiency will cause root tip dieback, leaf tip curl and marginal necrosis and chlorosis primarily in younger leaves. Blossom end rot and internal decay may also occur. Excess calcium may produce deficiencies in magnesium and potassium.

Magnesium is a component of the chlorophyll molecule and serves as a cofactor in most enzymes. Deficiency will exhibit a yellowing and interveinal chlorosis beginning in the older leaves. Extreme high levels will antagonize other ions in the nutrient solution.

Sulfate is involved in protein synthesis and is part of the amino acids, cysteine and thiamine, which are the building blocks of proteins. It is active in the structure and metabolism in the plant. It is essential for respiration and the synthesis breakdown of fatty acids. Sulfur deficiencies are light green fruit or younger leaves with a lack of succulence elongated roots and woody stem. Excess may cause early agedness.

SODIUM - CHLORIDE
Sodium seems to encourage crop yields and in specific cases it acts as an antidote agent against various toxic salts. It may act as a partial substitute for potassium deficiencies. Excess may cause plant toxicity or induce deficiencies of other elements. If sodium predominates in the solution calcium and magnesium may be affected.

Chloride is involved in the evolution of oxygen in the photosynthesis process and is essential for cell division in roots and leaves. Chlorine raises the cell osmotic pressure and affects stomata regulation and increases the hydration of plant tissue. Levels less than 140 ppm are safe for most plants. Chloride sensitive plants may experience tip or marginal leaf burn at concentrations above 20 ppm. Plants with chlorine deficiencies will be pale and suffer wilting. Excesses will cause burning of tips and margins, and bronzing of the leaves.

MICRO NUTRIENTS

BORON
Boron biochemical functions are yet uncertain, but evidence suggests it is involved in the synthesis of one of the bases for nucleic acid (RNA uracil) formation. It may also be involved in some cellular activities such as division, differentiation, maturation and respiration. It is associated with pollen germination. Plants deficient in boron exhibit brittle abnormal growth at shoot tips and one of the earliest symptoms is failure of root tips to elongate normally. Toxicity will cause yellowing before leaves die and prematurely fall off.

COPPER
Copper is a constituent of many enzymes and proteins. Assists in carbohydrate metabolism and nitrogen fixation in the process of oxygen reduction. Symptoms of deficiency are a reduced or stunted growth with a distortion of the younger leaves and growth tip dieback. Copper is required in very small amounts and readily becomes toxic in solution culture if not carefully controlled. Excess values will induce iron deficiency. Root growth will be suppressed.

IRON
Iron is an important component of plant enzyme systems for electron transport to carry electrons during photosynthesis and terminal respiration. It is a catalyst for chlorophyll production and is required for nitrate and sulfate reduction and assimilation. Interveinal chlorosis of younger leaves is the typical symptom of deficiency. Excess accumulation is rare but could cause bronzing or tiny brown spots on leaf surface.

MANGANESE
Manganese is involved in the oxidation reduction process in the photosynthetic electron transport system. Biochemical research shows that this element plays a structural role in the chloroplast membrane system, and also activates numerous enzymes. Interveinal chlorosis of younger leaves, necrotic lesions and leaf shredding are typical symptom of this deficiency. High levels can cause uneven distribution of chlorophyll resulting in blotchy appearance.

ZINC
Zinc plays a role in the same enzyme functions as manganese and magnesium. More than eighty enzymes contain tightly bound zinc essential for their function. Zinc participates in chlorophyll formation and helps prevent chlorophyll destruction. Carbonic anhydride has been found to be specifically activated by zinc. Deficiencies appear as chlorosis in the interveinal areas of new leaves producing a banding appearance. Branch terminals of fruit will die back in severe cases. Excess will cause sensitive plants to become chlorotic.

COBALT
Cobalt is essential to many beneficial bacteria that are involved in nitrogen fixation of legumes. It is a component of vitamin B12 which is essential to most animals and possibly in plants. Reports suggest that it may be involved with enzymes needed to form aromatic compounds. Otherwise, it is not understood fully as to its benefit to plant growth, but it is considered essential to some animal health issues.

MOLYBDENUM
Molybdenum is a component of two major enzyme systems involved in the nitrate re-educate, this is the process of conversion of nitrate to ammonium. Moly-deficiencies frequently resemble nitrogen, with older leaves chlorotic with rolled margins and stunted growth. Excess moly usually does not affect the plant.