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Plant Nutrition

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INTRODUCTION (top)

Fresh plant material is usually made up of between 80 and 95% water. So far, 16 elements have been identified as essential for plant growth. The plant cannot complete its life cycle without the element. Action of the element must be specific - no other element can take its place. The element must be directly involved (structure, constituent, enzyme activator, etc.)

PLANT NUTRIENTS (top)

Three elements absorbed in large amounts from the air, water and soil:

Carbon:
From carbon dioxide in the air. Converted into plant biomass by photosynthesis. All carbohydrates, proteins and fats are composed of a backbone of carbon atoms.
Deficiencies: Not usually a problem… However, in a closed greenhouse in winter, or early in the morning before the vents open, plants can use up enough carbon dioxide to slow photosynthesis and reduce growth. Recommend: CO2 generation.

Oxygen:
From the air, and as part of water molecules (H2O) and fertilizers (e.g., MgSO4). Component of carbohydrates, proteins and fats; necessary for respiration.
Deficiencies: Can be a problem within the root zone root rot, and plant death.

Hydrogen:
From water and fertilizers as above. Component of carbohydrates, proteins and fats.
Deficiencies: Usually not a problem.

Six "macro" nutrients absorbed in large amounts from the soil or a hydroponic solution: (top)

Nitrogen:
From fertilizers such as ammonium nitrate, potassium nitrate and/or calcium nitrate. Part of nucleic acids,

chlorophyll and every "amino" acid and therefore every protein,.
Deficiencies: (mobile) restricted growth and yellowing (chlorosis) of older leaves.

Phosphorus:
From fertilizers such as potassium phosphate. Part of the "energy currency" of cells (ATP, etc.), stimulates root/plant growth, maturity and blooming.
Deficiencies: (mobile) poor root/plant growth and flowering, "purplish" under leaves.

Potassium:
From fertilizers such as potassium nitrate and potassium phosphate. Acts as a catalyst or activator of enzymes, promotes overall growth, critical for stomata turgor.
Deficiencies: (mobile) poor growth, leaf chlorosis/necrosis (death), slowed gas exchange.

Calcium:
From fertilizers such as calcium nitrate. Primarily a cross-linking agent in cell walls.
Also involved in acid/base regulation during metabolism and as an enzyme activator.
Deficiencies: (not mobile) poor growth of meristems (growing tip), blossom end rot.

Magnesium:
From fertilizers such as magnesium sulfate. The "heart" of chlorophyll, and an activator for ATP/ADP metabolism, photosynthesis, respiration & DNA/RNA formation.
Deficiencies: (mobile) interveinal chlorosis/necrosis of lower mature leaves.

Sulfur:
From fertilizers such as magnesium sulfate or potassium sulfate. Part of 2 amino acids and therefore all proteins, forms sulfur bridges to establish and maintain protein structure.
Deficiencies: (slightly mobile) reduced growth in mid/young leaves, thin brittle stems.

Seven "micro" nutrients absorbed in small amounts from the soil or a hydroponic solution: (top)

Iron:
From ferrous sulfate, ferric chloride or iron chelate. Acts as a catalyst for enzymes involved in chlorophyll production, protein synthesis, respiration and other reactions.
Deficiencies: (immobile) interveinal chlorosis of young leaves.

Manganese:
From compounds such as manganese chloride. Involved in enzyme activation during carbohydrate reduction, chlorophyll and RNA/DNA synthesis and other reactions.
Deficiencies: (immobile) interveinal chlorosis of young leaves, necrotic spots, leaf shed.

Boron:
From compounds such as boric acid. Regulates carbohydrate metabolism; involved in RNA synthesis; probably related to the metabolism of calcium and potassium.
Deficiencies: (immobile in plant) poor growth, blackening then die back of roots/shoots.

Zinc:
From compounds such as zinc sulfate. Acts as an enzyme activator in protein, hormone (i.e., IAA) and RNA/DNA synthesis and metabolism; aids in ribosome complex stability.
Deficiencies: (immobile) general stunting esp. of young growth; interveinal chlorosis.

Copper:
From compounds such as copper chloride. Involved in chlorophyll synthesis; part of the photosynthetic electron transport pathway and of several oxidases, etc.
Deficiencies: (immobile) stunting, tip death, new leaf twist, blue-green leaves, necrosis, loss of turgor.

Molybdenum:

From compounds such as molybdenum trioxide. Involved in nitrogen and carbohydrate metabolism.
Deficiencies: (somewhat mobile) interveinal chlorosis, mottling and marginal scorching or inward cupping of older leaves.

Chlorine:
From compounds such as copper chloride or manganous chloride. Acts as an enzyme activator during photosynthesis; involved in respiration; regulation of cell turgor; etc.
Deficiencies: (mobile) older leaves chlorotic then necrotic; wilt; overall stunting.

A number of other elements have been found in plant tissue and are most likely required by some plants including sodium, silicon, cobalt, vanadium, iodine, bromine, fluorine, aluminum and nickel.

NUTRIENT SOLUTIONS (top)

Optimum plant growth and yield are the goals, thus watering and nutrition are critical. Optimum nutrient solutions begin with good quality and quantity water. Before starting any commercial operation, the water MUST be analyzed.

The source water should be fairly neutral pH (5-8) with low salt and heavy metal content. Low or high pH can affect nutrient uptake and salt and metals can affect plant growth.

Optimum plant growth is a function of nutrient concentration in the plant. There is a critical nutrient concentration below which growth is reduced/terminated. The adequate zone is above the critical concentration and provides maximum growth. The toxic zone is above the adequate zone, again resulting in reduced growth or death. THEREFORE, MORE IS NOT ALWAYS BETTER!

Nutrients are available in several forms, including pre-mixed liquid concentrates, pre-mixed powder concentrates, and "mix your own" varieties. In liquid concentrate form, calcium compounds are mixed separately from phosphates & sulfates since they will form insoluble precipitates and become unavailable to plants.

Nutrient recipes vary according to crop, life stage, environmental conditions, time of year, etc.

Questions? (top)

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