

Plant Nutrients and General Crop Nutrient Deficiency Symptoms

Sixteen chemical elements are known to be important to a plant's growth and survival. The sixteen chemical elements are divided into two main groups: non-mineral and mineral.

The **Non-Mineral Nutrients** are **hydrogen (H)**, **oxygen (O)**, & **carbon (C)**. These nutrients are found in the air and water. In a process called **photosynthesis**, plants use **energy from the sun** to change **carbon dioxide (CO₂ - carbon and oxygen)** and **water (H₂O- hydrogen and oxygen)** into starches and sugars. These starches and sugars are the plant's food. **Photosynthesis** means "making things with light". Since plants get carbon, hydrogen, and oxygen from the air and water, there is little farmers and gardeners can do to control how much of these nutrients a plant can use.

Mineral Nutrients - Soil: In general, most plants grow by absorbing nutrients from the soil. Their ability to do this depends on the nature of the soil. Depending on its location, a soil contains some combination of sand, silt, clay, and organic matter. The makeup of a soil (soil texture) and its acidity (pH) determine the extent to which nutrients are available to plants.

Macronutrients	Benefits	Symptoms of Deficiency
Nitrogen (N)	<ul style="list-style-type: none"> ◆ Nitrogen is a part of all living cells and is a necessary part of all proteins, enzymes and metabolic processes involved in the synthesis and transfer of energy. ◆ Nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis. ◆ Helps plants with rapid growth, increasing seed and fruit production and improving the quality of leaf and forage crops. ◆ Nitrogen often comes from fertilizer application and from the air (legumes get their N from the atmosphere, water or rainfall contributes very little nitrogen) 	Restricted growth of tops and roots; growth upright and spindly; leaves pale and yellowish-green in early stages, more yellow and even orange or red in later stages; deficiency shows up first on lower leaves.
Phosphorus (P)	<ul style="list-style-type: none"> ◆ Like nitrogen, phosphorus (P) is an essential part of the process of photosynthesis. ◆ Involved in the formation of all oils, sugars, starches, etc. ◆ Helps with the transformation of solar energy into chemical energy; proper plant maturation; withstanding stress. ◆ Effects rapid growth. ◆ Encourages blooming and root growth. ◆ Phosphorus often comes from fertilizer, bone meal, and superphosphate. 	Restricted growth of tops and roots; growth is upright and spindly; leaves bluish-green in early stages with green color sometimes darker than plants supplied with adequate phosphorus; more purplish in later stages with occasional browning of leaf margins; defoliation is premature, starting at the older leaves.
Potassium (K)	<ul style="list-style-type: none"> ◆ Potassium is absorbed by plants in larger amounts than any other mineral element except nitrogen and, in some cases, calcium. ◆ Helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. ◆ Potassium is supplied to plants by soil minerals, organic materials, and fertilizer. 	Browning of leaf tips; marginal scorching of leaf edges; development of brown or light colored spots in some species which is usually more numerous near the margins; deficiency shows up first on lower foliage.
Calcium (Ca)	<ul style="list-style-type: none"> ◆ Calcium, an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength in the plant. It is also thought to counteract the effect of alkali salts and organic acids within a plant. ◆ Sources of calcium are dolomitic lime, gypsum, and superphosphate. 	Deficiency occurs mainly in younger leaves near the growing point; younger leaves distorted with tips hooked back and margins curled backward or forward; leaf margins may be irregular and display brown scorching or spotting.

Macronutrients (cont.)	Benefits	Symptoms of Deficiency
Magnesium (Mg)	<ul style="list-style-type: none"> ◆ Magnesium is part of the chlorophyll in all green plants and essential for photosynthesis. It also helps activate many plant enzymes needed for growth. ◆ Soil minerals, organic material, fertilizers, and dolomitic limestone are sources of magnesium for plants. 	Interveinal chlorosis with chlorotic areas separated by green tissue in earlier stages giving a beaded streaking effect; deficiency occurs first on lower foliage.
Sulfur (S)	<ul style="list-style-type: none"> ◆ Essential plant food for production of protein. ◆ Promotes activity and development of enzymes and vitamins. ◆ Helps in chlorophyll formation. ◆ Improves root growth and seed production. ◆ Helps with vigorous plant growth and resistance to cold. ◆ Sulfur may be supplied to the soil from rainwater. It is also added in some fertilizers as an impurity, especially the lower grade fertilizers. The use of gypsum also increases soil sulfur levels. 	Younger foliage is pale yellowish-green, similar to nitrogen deficiency; shoot growth somewhat restricted.
Micronutrients	Benefits	Symptoms of Deficiency
Boron (B)	<ul style="list-style-type: none"> ◆ Helps in the use of nutrients and regulates other nutrients. ◆ Aids production of sugar and carbohydrates. ◆ Essential for seed and fruit development. ◆ Sources of boron are organic matter and borax 	Growing points severely affected; stems and leaves may show considerable distortion; upper leaves are often yellowish red and may be scorched or curled.
Chlorine (Cl)	<ul style="list-style-type: none"> ◆ Aids plant metabolism ◆ Chlorine is found in the soil 	Deficiency not observed under field conditions.
Copper (Cu)	<ul style="list-style-type: none"> ◆ Important for reproductive growth. ◆ Aids in root metabolism and helps in the utilization of proteins. 	Younger leaves become pale green with some marginal chlorosis.
Iron (Fe)	<ul style="list-style-type: none"> ◆ Essential for formation of chlorophyll. ◆ Sources of iron are the soil, iron sulfate, iron chelate. 	Interveinal chlorosis of younger leaves.
Manganese (Mn)	<ul style="list-style-type: none"> ◆ Functions with enzyme systems involved in breakdown of carbohydrates, and nitrogen metabolism. ◆ Soil is a source of manganese. 	Light green to yellow leaves with distinctly green veins; in severe cases, brown spots appear on the leaves and the leaves are shed; usually begins with younger leaves.
Molybdenum (Mo)	<ul style="list-style-type: none"> ◆ Helps in the use of nitrogen ◆ Soil is a source of molybdenum 	Leaves become chlorotic, developing rolled or cupped margins; plants deficient in this element often become nitrogen deficient.
Zinc (Zn)	<ul style="list-style-type: none"> ◆ Essential for the transformation of carbohydrates. ◆ Regulates consumption of sugars. ◆ Part of the enzyme systems which regulate plant growth. ◆ Sources of zinc are soil, zinc oxide, zinc sulfate, zinc chelate. 	Interveinal chlorosis followed by a die back of chlorotic areas.

