CAYMAN ISLANDS
DEPARTMENTOFAGRICULTURE
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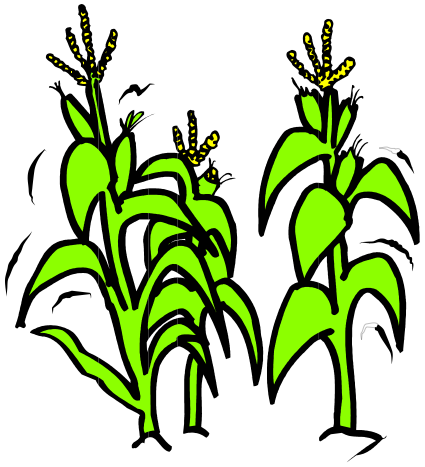
Principles of Plant Nutrition

Information Sheet



Fertilizer Basics

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Material obtained from North Carolina State University Bulletin

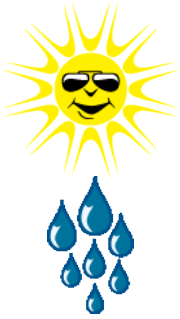
NOTES:

Plant Nutrients

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.**

Non-Mineral Nutrients

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** (CO_2 - carbon and oxygen) and **water** (H_2O- 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

The **13 mineral nutrients**, which come from the soil, are dissolved in water and absorbed through a plant's roots. There are not always enough of these nutrients in the soil for a plant to grow healthy. This is why many farmers and gardeners use fertilizers to add the nutrients to the soil.
The mineral nutrients are divided into two groups: **macronutrients** and **micronutrients**.

Macronutrients

Macronutrients can be broken into two more groups: **primary** and **secondary nutrients**.

The **primary nutrients** are **nitrogen (N)**, **phosphorus (P)**, and **potassium (K)**. These major nutrients usually are lacking from the soil first because plants use large amounts for their growth and survival.

The **secondary nutrients** are **calcium (Ca)**, **magnesium (Mg)**, and **sulfur (S)**. There are usually enough of these nutrients in the soil so fertilization is not always needed. Sulfur is usually found in sufficient amounts from the slow decomposition of soil organic matter, an important reason for not throwing out grass clippings and leaves.

Micronutrients

Micronutrients are those elements essential for plant growth which are needed in only very small (micro) quantities . These elements are sometimes called minor elements or trace elements, but use of the term micronutrient is encouraged by the American Society of Agronomy and the Soil Science Society of America. The micronutrients are **boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese (Mn), molybdenum (Mo)** and **zinc (Zn)**. Recycling organic matter such as grass clippings and tree leaves is an excellent way of providing micronutrients (as well as macronutrients) to growing plants.

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.

Soil Texture (the amount of sand, silt, clay, and organic matter in the soil)

Soil texture affects how well nutrients and water are retained in the soil. Clays and organic soils hold nutrients and water much better than sandy soils. As water drains from sandy soils, it often carries nutrients along with it. This condition is called leaching. When nutrients leach into the soil, they are not available for plants to use.
An ideal soil contains equivalent portions of sand, silt, clay, and organic matter. Soils across the Cayman Islands vary in their texture and nutrient content, which makes some soils more productive than others. Sometimes, the nutrients that plants need occur naturally in the soil. Other times, they must be added to the soil as fertilizer.

Soil pH (a measure of the acidity or alkalinity of the soil)

Soil pH is one of the most important soil properties that affects the availability of nutrients.

Macronutrients tend to be less available in soils with low pH.

Micronutrients tend to be less available in soils with high pH.

At the pH range of 6.0—6.5, nutrients are more readily available to plants, and microbial populations in the soil increase. **Microbes** convert nitrogen and sulfur to forms that plants can use.

It is a good idea to have your soil tested. If you do, you will get a report that explains how much fertilizer your crop needs.

Plant Nutrition

Plants need 16 elements for normal growth. Carbon, hydrogen, and oxygen are found in air and water. Nitrogen, potassium, magnesium, calcium, phosphorous, and sulfur are found in the soil. These six elements are used in relatively large amounts by the plant and are called macronutrients. There are eight other elements that are used in much smaller amounts and are called micronutrients, or trace elements. The micronutrients, which are found in the soil, are iron, zinc, molybdenum, manganese, boron, copper, and chlorine. All 16 elements, both macronutrients and micronutrients, are essential for plant growth.

Macronutrients	Deficiencies	Remarks
Nitrogen (N) - Part of proteins, enzymes, chlorophyll, and growth regulators.	Reduced growth, yellowing (chlorosis), reds and purples may intensify with some plants, reduced lateral breaks.	Excess will yield all leaf and stem growth, with little fruit.
Phosphorus (P) - Role in fat, carbon, hydrogen, and oxygen metabolism; respiration and photosynthesis.	Reduced growth, color may intensify, foliage turning brown or purple in some plants; thin stems, loss of lower leaves, reduced flowering.	In very acid or alkaline soils, phosphorus will be unavailable.
Potassium (K) - Important in starch formation, sugar translocation, water relations, disease resistance, chlorophyll development, and tuber formation.	Reduced growth, shortened internodes, marginal burn or brown leaf edges, dead spots in the leaf, reduction of lateral breaks, and tendency to wilt readily.	Large amounts of potash are needed by most plants.
Magnesium (Mg) - Part of chlorophyll, enzyme activator; important in energy utilization.	Reduction in growth; yellowing between veins, also can occur with middle or lower leaves; reduction in seed production.	Interferes with calcium uptake if used in excess.
Calcium (Ca) - Important in cell wall structure, cell division, enzymes, and as an enzyme activator.	Inhibition of bud growth, death of root tips, cupping of mature leaves, weak growth.	Too much calcium will result in high pH, causing many of the micronutrients to become unavailable to the plant.
Sulfur (S) - Part of protein, amino acids, vitamins; important in respiration.	Symptoms are a general yellowing of the affected leaves of the entire plant.	

When you're providing those extra nutrients for your plants, be sure to measure fertilizers accurately and apply them safely. Fertilizer run-off ends up in nearby streams and ultimately upsets the water quality in your community

Macronutrients

Nitrogen (N)

- 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)

Phosphorus (P)

- 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 super phosphate.

Potassium (K)

- 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.

Calcium (Ca)

- 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.

Magnesium (Mg)

- 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.

Sulfur (S)

- 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.

Micronutrients

Boron (B)

- 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

Copper (Cu)

- Important for reproductive growth.
- Aids in root metabolism and helps in the utilization of proteins.

Chloride (Cl)

- Aids plant metabolism.
- Chloride is found in the soil.

Iron (Fe)

- Essential for formation of chlorophyll.
- Sources of iron are the soil, iron sulfate, iron chelate.

Manganese (Mn)

- Functions with enzyme systems involved in breakdown of carbohydrates, and nitrogen metabolism.
- Soil is a source of manganese.

Molybdenum (Mo)

- Helps in the use of nitrogen
- Soil is a source of molybdenum.

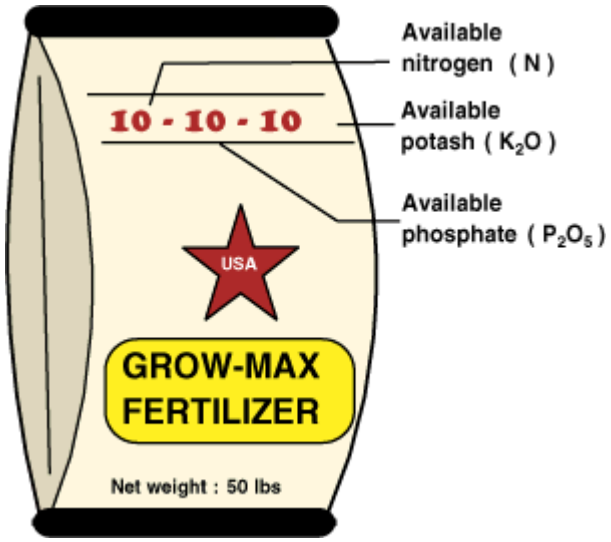
Zinc (Zn)

- 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.

A Homeowner's Guide to Fertilizer

Understanding the Fertilizer Label



All fertilizer labels have three bold numbers. The first number is the amount of nitrogen (N), the second number is the amount of phosphate (P_2O_5) and the third number is the amount of potash (K_2O). These three numbers represent the primary nutrients (nitrogen(N) - phosphorus(P) - potassium(K)).
This label, known as the fertilizer grade, is a national standard.
A bag of 10-10-10 fertilizer contains 10 percent nitrogen, 10 percent phosphate and 10 percent potash.

Fertilizer grades are made by mixing two or more nutrient sources together to form a blend, that is why they are called "mixed fertilizers." Blends contain particles of more than one color. Manufacturers produce different grades for the many types of plants.

You can also get fertilizers that contain only one of each of the primary nutrients. Nitrogen sources include ammonium nitrate (33.5-0-0), urea nitrogen (46-0-0), sodium nitrate (16-0-0) and liquid nitrogen (30-0-0). Phosphorus is provided as 0-46-0 and potash as 0-0-60 or 0-0-50.

Calculating Nutrient Content

To calculate the pounds of nitrogen in a **50-lb bag of 10-10-10 fertilizer**, multiply 50 by 0.10. Do the same for calculating the amounts of phosphate and potash. A 50-lb bag of 10-10-10 contains a total of 15 lbs of nutrients: 5 lbs nitrogen, 5 lbs phosphate and 5 lbs potash. The remaining weight is filler, usually sand or granular limestone.

Another example:

50-lb. bag of 8-0-24 fertilizer

1. To calculate the pounds of nitrogen: Multiply 50 by .08, which equals 4.
2. To calculate the pounds of phosphate: There is no phosphate in this bag of fertilizer.
3. To calculate the pounds of potash: Multiply 50 by .24, which equals 12.
   A 50 pound bag of 8-0-24 fertilizer contains a total of 16 lbs of nutrients: 4 lbs nitrogen, 0 lbs phosphate, and 12 lbs potash. This would leave us with 34 lbs of filler.