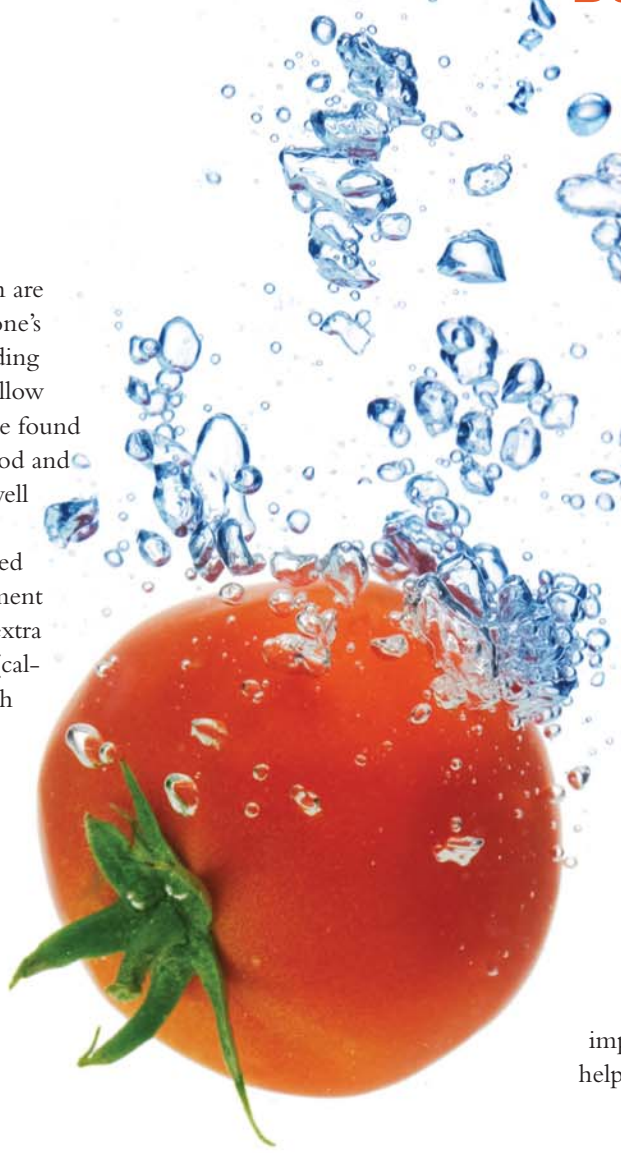
Calcium and Magnesium

Beyond the Obvious

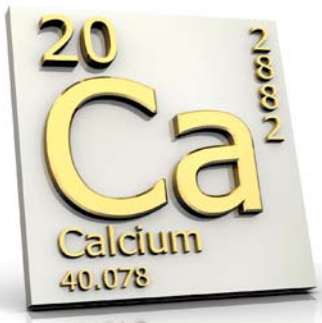


Introduction

Calcium and magnesium are common inputs in everyone's garden. They are the building blocks and catalysts that allow plants to flourish. They are found in the soil and in plant food and in tap water, with some well sources having extreme amounts. Most experienced gardeners tend to supplement their feed regimen with extra calcium and magnesium (cal-mag), especially those with hydroponic gardens.

by Richard Gellert

Common knowledge has it is that cal-mag is pretty straight forward, that there is not much variation between the different kinds on the market or in your tap water. But is all cal-mag created equal? Would some forms of these minerals perform better than others? What forms are leading nutrient manufacturers using? How can you tell if you have a deficiency? What leads to these deficiencies and most importantly how can you avoid them? These are just some of the questions this article will attempt to answer. I will help refine your knowledge of these important components in your garden so they can help you achieve the highest quality and maximum yields of your favorite fruits and veggies.



Cal-Mag's Key Role in the Garden

Calcium, an essential part of the plant's cell wall structure, improves the absorption of other nutrients by the roots and their translocation within the plant. It activates a number of plant growth-regulating enzyme systems; helps convert nitrate-nitrogen into forms needed for protein formation; and contributes to improved disease resistance.

Calcium is an intracellular messenger as well and can send a signal from one cell to another telling other cells how to react or what to do. It also provides for the transport and retention of many other elements. Calcium, magnesium and potassium live in a delicate balance within plants. Too much of one will inhibit the other two. Finally, calcium is a co-factor in many enzymatic reactions. Its presence is needed to turn an enzyme on or off and allow it to catalyze a reaction.

Magnesium is part of the chlorophyll in all plants. Magnesium is the central core of the chlorophyll molecule in green plant tissue and essential for photosynthesis. Thus, if magnesium is deficient, the shortage of chlorophyll results in poor and stunted plant growth. Magnesium also helps to activate specific enzyme systems. Enzymes are complex substances that build, modify or break down compounds as part of a plant's normal metabolism.

Most growers incorporate higher levels of cal-mag (around 50 to 200ppm) during the first two weeks of bloom. This is when the plant takes up a higher concentration of calcium and magnesium to help facilitate the rapid division of cells, changing the plant from a vegetative process to a reproductive process. Also, during main flower set four to six weeks into the flowering process, additional cal-mag is required.

Roy Gomez, owner of Humboldt Nutrients, had a very specific viewpoint about supplementing extra calcium. "I believe that calcium should be supplemented in a feeding regimen in the early vegetative and early bloom stages. As young children, we are told to consume milk as a calcium supplement for strengthening bone density and structure. Young plants should also receive this calcium supplement to help their stock, density and plant structure."

Magnesium is part of the chlorophyll in all plants.

The Different Forms

Calcium and magnesium are found in most plant nutrients. They are also available combined into one bottle as a supplement. Some companies go one step further and separate the two giving one the ability to really dial in the perfect feed recipe. The ratio of calcium to magnesium can vary and be very specific to a particular type of plant.

Calcium and magnesium are also the most abundant minerals in tap water. The majority of the PPM, or EC reading, you obtain from a measuring device is cal-mag. The most typical form of these minerals in your untreated water is calcium carbonate and magnesium carbonate. Unfortunately, contrary to popular belief, these forms are virtually unusable by plants, especially fast growing plants. The molecules of these compounds are far too large and immobile to be absorbed by the roots and transported to where the plant needs them. Relying on the cal-mag in tap water can lead to many problems which we will discuss later in this article.

Nutrient manufacturers use different forms of cal-mag and base their decision on what they feel delivers the most benefits to the type of plants they have targeted with their plant food and supplements. Below are a few examples of calcium and magnesium compounds used by nutrient manufactures:

- **Calcium Nitrate**
- **Calcium Carbonate**
- **Calcium Chloride**
- **Calcium Gluconate**
- **Calcium Proteinate**
- **Calcium Acetate**
- **Magnesium Nitrate**
- **Magnesium Carbonate**

"Naturals chelates harnesses the power of nature's smallest creatures to "fix" plant food for easy uptake."

Beyond the various compounds of these two minerals there are chelators which are used to make the cal-mag more readily available. There are vast differences in what manufacturers use to chelate their cal-mag. Most typical synthetic chelators are EDTA, DPTA and EDDHA and are classified as poly-amino carboxylic acids. Naturals chelates are also used and include humic and fulvic acid, organic amino acids or a micro-organism based chelation process, which harnesses the power of nature's smallest creatures to "fix" plant food for easy uptake.

Calcium is always used as CA2+ within plants, but how it gets into the plant is a whole other story. Each of the various forms of calcium each has different absorption co-efficients. Each form of calcium is absorbed into the cell at different rates and requires a different method for the cell to take it in. Each method requires more or less energy for the cell to exert to do so. Some highly chelated forms of cal-mag can enter the plant's phospholipid membrane through osmosis. The quicker the cal-mag can be absorbed, the more efficiently the plant can make use of these compounds, thus facilitating lightning fast growth and cell division.

Calcium and magnesium are the most abundant minerals in tap water.

Calcium Deficiencies

Calcium deficiency symptoms appear initially as generally stunted plant growth. Necrotic (dead) leaf margins on young leaves or necrosis around the base of the leaves is very common. In its advanced stage it can eventual lead to death of the terminal buds and root tips. Generally the new growth of the plant is affected first. The mature leaves may be affected if the problem persists. Cupping of mature leaves is a tell tale sign of a calcium deficiency.

Classic symptoms of a calcium deficiency include blossom-end rot of tomato (death of the end part of the fruits), tip burn of lettuce, blackheart of celery and death of the growing regions in many plants. All these symptoms show soft, dead necrotic tissue at rapidly growing areas.

Generally, a calcium deficiency is related to poor translocation of calcium to the tissue rather than a low external supply of calcium. Calcium has a very low mobility in plants which makes this one of the most common problems in a garden. Calcium may be available externally but it is in the wrong form for the plant to absorb readily.

Magnesium Deficiencies

Deficiencies typically occur with the middle or lower leaves. The most common symptoms are interveinal chlorosis or

The most common cause of calcium and magnesium deficiencies is lockout, which is caused by too large cal-mag molecules accumulating on the outside of roots.

yellowing between leaf veins, which stay green, giving a marbled appearance. Necrosis, or death, can develop in the highly chlorotic tissue. The symptoms generally start with mottled chlorotic areas developing in the interveinal tissue and spreads to large dead spots. This begins with older leaves and spreads to younger growth.

Magnesium deficiencies are usually confused with a virus, or natural aging in the case of tomato plants. In its advanced form, a magnesium deficiency may superficially resemble a potassium deficiency. The tell tale sign of a magnesium deficiency is the interveinal chlorosis produces a raised puckered surface, with the top of the puckers progressively going from chlorotic to necrotic tissue. Other symptoms of this deficiency are fruits and vegetables tend to be small and woody while flowers never develop to their full potential.

Roy Gomez understands the important role of magnesium and states, "As aging adults, it is not uncommon for people to become magnesium deficient. There are multiple sources of magnesium supplements in the health food market. I believe that magnesium is an important element to supplement in an aging plants life. Certain plants consume large amounts of magnesium during the early and late flowering stages. If magnesium deficiencies occur in plants, it causes late-season yellowing in leaf veins and older leaves."

"Fulvic and humic acid, as well as living beneficial biology, can help break down the relatively immobile cal-mag in your tap water."

How Cal-Mag Deficiencies Occur

The most common cause of calcium and magnesium deficiencies is lockout. When there is too much cal-mag already in the untreated source water being used as the base to the nutrient formula it can cause the good cal-mag in the plant food to become unavailable. Think about it this way - the cal-mag in your tap water has a large molecular structure and is very immobile in that form. These molecules try to go through your roots and up into the plant where they can be used. The molecules are too large to be absorbed efficiently and end up accumulating on the outside of the roots.

Best Practices to Avoid Problems

The most ideal way to avoid deficiencies is by starting with a base of purified water. That way you are not guessing how much cal-mag you have and you won't be as susceptible to lock out problems. Reverse osmosis technology removes 95 to 99 per cent of all contaminants and the most efficient method to rid your tap water of the majority of cal-mag and other PPMs.

After having the cleanest base available you want to select cal-mag that is formulated specifically for horticulture. Going beyond this, look for labels that list several different sources or compounds of cal-mag and ensure that they have been chelated to make them that much more available to your plants. If growing organically, it is paramount that you select cal-mag supplements that have been chelated naturally with amino acids or living biology. By using these highly absorbable forms of cal-mag you are helping to ensure the healthiest and quickest growing plants.

Some nutrient manufacturers address the excessive cal-mag in tap water by marketing hard water formulas.

"Although a grower can use a hard water formula for his or her plants, it doesn't mean they should," said Brantley Pierce of Green Coast Hydroponics. "In many relations, people are the same as plants - what you put in is what you get out. We can feed ourselves fast food everyday to become full, but it doesn't mean that is the best choice for living. Starting with R.O. water and building a quality nutrient profile from scratch is like home cooking. It takes more preparation and time but the results equal a higher quality of life."

Finally, there are some brands of cal-mag that have been super chelated with living biology and are readily available to your plants. These types of cal-mag can actually be foliar sprayed on the leaves and absorbed in a matter of hours. Results can be seen amazingly fast and deficiency problems can be corrected in a matter of days.

In conclusion, it is clear that calcium and magnesium play significant roles in everyone's garden. Having the proper forms and correct amounts will determine the final outcome of your harvest. Starting with a base of purified water and supplementing the feed formula with specific, very usable forms of cal-mag will ensure healthy and happy harvests. Pure water is the platform for continued success in the garden. MY

Visit *www.maximumyield.com* to learn more about the variety of cal-mag compounds and how they supplement nutrition to targeted plants.