

Calcium

What is it and what does it do?

- Is important to the growth process.
- Has a regulating effect in the cells and contributes to the stability of the plant.

What can you see?

Yellow/brown spots, surrounded by a sharp brown outlined edge.

What can you do?

Add calcium by applying a liquid lime fertiliser such as a calcium nitrate solution.

Phosphorus

What is it and what does it do?

- Holds key position in both cell processes and total energy transfer of the plant.
- Also a "building block" of - amongst others - cell walls and DNA.

What can you see?

- Small plant with purple/black necrotic leaf parts.
- Leaves become malformed and shrivelled.

What can you do?

Mix inorganic phosphate fertiliser THOROUGHLY through the potting mix or add extra liquid phosphate when growing in hydroponics.

Magnesium

What is it and what does it do?

- Magnesium is indispensable to plants as it is essential for photosynthesis.
- Represents a building block for chlorophyll.

What can you see?

- Rusty brown spots.
- Cloudy, vague yellow spots between the veins.

What can you do?

Spray with a 2% solution of Epsom salts every 4-5 days during about a week.

Iron

What is it and what does it do?

Iron has a number of important functions in the plant's overall metabolism and is essential for the synthesis of chlorophyll.

What can you see?

- Strong yellowing of especially the young leaves.
- Growth shoots between the veins.

What can you do?

The best thing is to spray the plants with a watery solution of EDDHA or EDTA chelates.

Nitrogen

What is it and what does it do?

Nitrogen is a component of enzymes and is therefore involved in all enzyme reactions and plays an active role in the plant's metabolism.

What can you see?

- Purple stalks.
- Yellowing leaves.
- Leaves falls of.

What can you do?

Raise EC of the feeding or add extra nitrogen.

Potassium

What is it and what does it do?

- Potassium takes care of the strength and the quality of the plant.
- Controls countless other processes such as the carbohydrate system.

What can you see?

Dead edges on the leaves.

What can you do?

- In case the EC in the substrate or potting mix is high, you can rinse it with clean water.
- Add potassium yourself.

Manganese

What is it and what does it do?

The metal manganese is an essential trace nutrient and acts as an activator for different enzyme reactions in the plant.

What can you see?

Yellow stripes appear between the leaf's side veins.

What can you do?

Using products that contain trace elements (Tracemix).

Curly, purple or yellowing leaves? Or leaves with brown or yellow spots? These are just a few of deficiency symptoms that growers might encounter. It's cold comfort to know that even the best and most experienced growers have dealt with deficiencies at sometime or another. But we have good news for you and for anyone else who is likely to encounter a nutrient deficiency at least once in their growing career: the CANNA Deficiency Guide is the perfect guide in times of need.

Calcium, Phosphorus, Nitrogen, Potassium, Manganese, Magnesium and Iron are the primary nutrients that plants need. If you come up against a deficiency in one of the elements in your plant(s), you are in some serious trouble. Brown spots, yellow spots, burned leaves and leaves falling off are just some examples. And if you don't come up with a solution quickly, your beloved plant(s) may pass the point of no return.

The CANNA Deficiency Guide is a great help. It gives you a bit of background information about each nutrient, explains the symptoms, development and reasons for a deficiency, and provides you with a solution at the end. The images really help you to recognize which nutrient deficiency you are dealing with. That said, if you use CANNA products, you will be reducing the risk of a deficiency anyway. That's not only because this range of innovative products has been developed by the highly trained specialists at CANNA Research, but also because CANNA shares its expertise and provides growers with a full package of growing information with the magazine CANNAtalk and the website www.cannagardening.com.

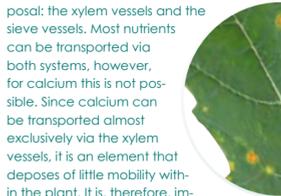
FIRST AID FOR DEFICIENCIES

CANNA Info Courier

Calcium

About calcium in short

Calcium occurs throughout the entire plant. It is used for many processes in the plant, however, calcium is most important for the growth process. It has a regulating effect in the cells and contributes to the stability of the plant. Plants have two transportation systems at their disposal: the xylem vessels and the sieve vessels. Most nutrients can be transported via both systems, however, for calcium this is not possible. Since calcium can be transported almost exclusively via the xylem vessels, it is an element that deposits of little mobility within the plant. It is, therefore, important that a sufficient amount of calcium is always available in the root environment, so that it will be continuously available for absorption by the plant.



Symptoms of a deficiency
The older, larger leaves just above the bottommost ones will show the first symptoms. Yellow/brown spots occur, which are often surrounded by a sharp brown outlined edge. In addition, the growth is curbed and in serious cases the tops are smaller than normal and do not close.

Development of a deficiency
The symptoms often appear quickly; within one or two weeks of the first spots being visible on the older leaves. The spots usually start as small, light brown specks that increase in size over time.

• After two weeks, the older leaves show ever increasing spots and the spots also often appear at the edge of the leaves, as with a potassium deficiency or with scorch symptoms. The spots have a sharp outline and do not originate exclusively at the edge of the leaves. A lag in develop-

ment is often already noticeable within a week.

• Sometimes the growing points will wrinkle up and around the fruits you will find thin, small leaves that are not spotted.

• The older leaves die off slowly and yellowish cloudy spots may appear around the necrotic spots. The older the leaf is, the more serious the symptoms are.

• The flowering is also hindered and slowed down. Fruits stay small.

• An excessive amount of ammonium, potassium, magnesium and/or sodium in the root environment. The absorption is curbed mostly by ammonium and least by sodium.

• Problems with the evaporation caused by an excessively high EC value or by excessively high or low relative humidity.

• If the EC value of the substrate or the potting mix is too high, it can be easily rinsed out with pure and if necessary acidified water.

• Additional calcium can be applied through the nutrient solution by means of liquid lime fertilisers such as a calcium nitrate solution. With an excessively acidic potting mix, lime milk can be used to increase the pH. Use the appropriate potting mix that is not too acidic. Acid potting mix often contains insufficient amounts of lime. Good potting mix and Coco substrates are already limed.

For your information: Be careful with fertilisers containing chloride.

Phosphorus

About phosphorus in short

Phosphorus plays an important role for all living organisms and is an essential nutrient element for plants and animals. It has a key position in the combustion processes of the cell, and in the total energy transfer of the plant. It is also a "building block" of the cell walls, the DNA, and all sorts of proteins and enzymes. For young plants, the presence of phosphate is indispensable; about 3/4 of the phosphorus consumed during a plant's life cycle is absorbed in the first quarter of its life. The largest concentrations of phosphorus are found in the developing parts of the plant: the roots, the growth shoots and the vascular tissue.



Symptoms of a deficiency
Plants remain rather small with purple/black necrotic leaf parts, which later on become malformed and shrivelled.

Development of a deficiency
• At first, the plant becomes dark green - a different sort of dark green (blue/green) as appears when there is a shortage of potassium.

• The growth in height, and the development of the plant's side shoots are inhibited.

• After 2 to 3 weeks, dark purple/black necrotic spots appear on the old and medium-old leaves, making the leaves malformed.

Reasons for a deficiency
Due to the low concentrations in which phosphate appears in nature, the affinity of plant cells for phosphorus allows easy absorption through the whole root. Therefore, shortages do not happen very often, except when:

• The growing medium has a too high pH (higher than pH 7). In such cases the plant can not absorb phosphorus due to the fact that insoluble phosphorus compounds develop.

• The ground is too acidic, or too rich in iron and zinc. This hinders the absorption of phosphate.

• The potting mix has become fixated. Phosphate can not be absorbed any more.

Solutions to a deficiency
Always use inorganic phosphates as these are easy to absorb. Also always mix the phosphate fertiliser THOROUGHLY through the potting mix.

• When pH is too high, acidify the medium by using a thinned solution of phosphoric acid.

• Choose products that have a guaranteed phosphate percentage on the packaging instead of alternative phosphate-containing products like guano or manure.

• The growth in height, and the development of the plant's side shoots are inhibited.

• After 2 to 3 weeks, dark purple/black necrotic spots appear on the old and medium-old leaves, making the leaves malformed.

Magnesium

About magnesium in short

Magnesium is an indispensable element for - amongst others - plants. In plants, it represents a building block for chlorophyll (leaf green), and therefore, it is essential for photosynthesis. At the same time, magnesium plays an important role in the energy transfer. Together with calcium, it is also a component



Symptoms of a deficiency
When there is a shortage, the leaf green in the medium-old leaves under the flowering top will be broken up, and the magnesium will be transported into the young parts of the plant. This breakdown is visible as rusty brown spots and/or vague, cloudy, yellow spots between the veins. A slight shortage of magnesium hardly affects flowering, although the development of the flowers make the deficiency symptoms worse.

Development of a deficiency
• Signs of a deficiency first appear around the 4th-6th week. Small, rusty brown spots and/or cloudy yellow flecks appear in the middle-aged leaves (under the top of the plant).

• The colour of the young leaves and the fruit development are not affected.

• The size and number of rust-brown spots on the leaves increase.

Reasons for a deficiency

The magnesium deficiency can occur because uptake is inhibited because of:

• A very wet, cold and/or acidic root environment.

• A high quantity of potassium, ammonia and/or calcium (for instance high concentrations of calcium carbonate in drinking water, or clay potting mixes rich in calcium) in comparison with the quantity of magnesium.

• A limited root system and heavy plant demands.

• A high EC in the growing medium, which hinders evaporation.

• When pH is too high, acidify the medium by using a thinned solution of phosphoric acid.

• Choose products that have a guaranteed phosphate percentage on the packaging instead of alternative phosphate-containing products like guano or manure.

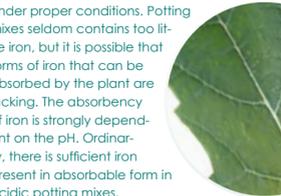
• The growth in height, and the development of the plant's side shoots are inhibited.

• After 2 to 3 weeks, dark purple/black necrotic spots appear on the old and medium-old leaves, making the leaves malformed.

Iron

About iron in short

Iron is a vital element for plant life. Iron has a number of important functions in the overall metabolism of the plant and is essential for the synthesis of chlorophyll. In general, iron is poorly absorbed by the plant. It can only be sufficiently taken up by the roots in certain forms and under proper conditions. Potting mixes seldom contains too little iron, but it is possible that forms of iron that can be absorbed by the plant are lacking. The absorbency of iron is strongly dependent on the pH. Ordinarily, there is sufficient iron present in absorbable form in acidic potting mixes.



Symptoms of a deficiency
Iron deficiency can occur during periods of heavy growth or high plant stress and is characterised by a strong yellowing of the young leaves and the growth shoots between the veins. This occurs chiefly because iron is not mobile in the plant. The young leaves can't draw any iron from the older leaves. With a serious iron shortage, the older leaves and the smaller veins in the leaf can also turn yellow.

Development of a deficiency
• Green/yellow chlorosis, from inside to the outside in the younger leaves and in the growth shoots. The veins remain mostly green.

• Continued yellowing of the leaves to sometimes almost white. Also, large leaves turn yellow. This inhibits growth.

• In serious cases the leaves show necrosis, and the plant's growth and flowering are inhibited.

Reasons for a deficiency

• The pH in the root environment is too high (pH > 6.5).

• The root environment contains a lot of zinc and/or manganese.

• The concentration of iron is too low in the root environment.

• The root temperature is low.

• The root medium is too wet, causing the oxygen supply in the roots to stagnate.

• The root system functions inefficiently due to damaged, infected or dead roots.

• There is too much light on the nutrition tank; light promotes the growth of algae. Algae also use up the iron and break down iron chelates.

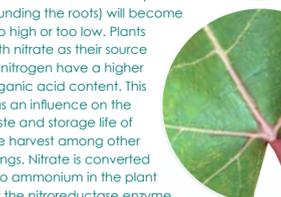
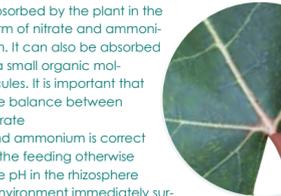
• Iron chelates can be added to the substrate.

• Drainage can be improved, or the ground temperature can be increased.

Nitrogen

About nitrogen in short

Nitrogen is one of the important elements a plant needs. It is an important part of proteins, chlorophyll, vitamins, hormones and DNA. Because it is a component of enzymes, nitrogen is involved in all enzyme reactions and plays an active role in the plant's metabolism. Nitrogen is mainly absorbed by the plant in the form of nitrate and ammonium. It can also be absorbed via small organic molecules. It is important that the balance between nitrate and ammonium is correct in the feeding otherwise the pH in the rhizosphere (environment immediately surrounding the roots) will become too high or too low. Plants with nitrate as their source of nitrogen have a higher organic acid content. This has an influence on the taste and storage life of the harvest among other things. Nitrate is converted into ammonium in the plant by the nitroreductase enzyme. Ammonium is then assimilated into organic molecules. Nitrogen has a positive influence on the plant's growth. The plant gets bigger leaves, more branches and the vegetative period is extended.



Symptoms of a deficiency
Stalks will turn purple and leaves will yellow and finally fall off.

Development of a deficiency
• Quickly followed by larger leaves in the middle and top parts of the plant.

• The plant is a lighter colour as a whole.

• Larger leaves in the lower part of the plant turn light green. The leaf stalks of the smaller leaves now also turn purple. Typical vertical purple stripes appear in the stem.

• Leaves in the lower part of the plant turn more yellow and then become white. Finally, the leaves whither and fall off.

• The growth is visibly inhibited giving short-er plants, thinner stems, less leaf formation and smaller leaves.

• Further yellowing and whitening occurs in the top and middle parts of the plant.

• Leaves on growing points remain green longer but they are a lot less green than at normal nitrogen levels.

• Forced flowering starts and there is substantial leaf loss. Substantial reduction in yield.

• Deficiency can be caused by incorrect feeding or giving feeding that contains insufficient nutrient elements. Substrates that contain a lot of fresh organic material can cause nitrogen deficiency because micro-organisms bind the nitrogen. A lot of nitrogen can be bound, particularly in the first weeks; this is released later but it is generally too late.

• Raise the EC of the feeding and rinse the substrate well with it.

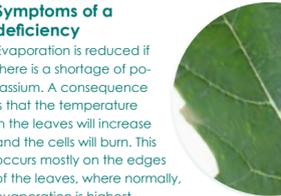
• Add nitrogen yourself to the feeding solution by using urea, blood meal, semi-liquid manure or by using a special "mono-nutrient" product.

• Spray the underside of the leaves with a nitrogen solution. This can best be done at the end of the day, just before the lights are turned off. Be careful not to cause burning.

Potassium

About potassium in short

It is necessary for all activities having to do with water transport and the opening and closing of the stomas. Potassium takes care of the strength and the quality of the plant and controls countless other processes such as the carbohydrate system.



Symptoms of a deficiency
Evaporation is reduced if there is a shortage of potassium. A consequence is that the temperature in the leaves will increase and the cells will burn. This occurs mostly on the edges of the leaves, where normally, evaporation is highest.

Development of a deficiency
• Tips of the younger leaves show grey edges.

• Leaves turn yellow from the edge in the direction of the veins and rust-coloured dead spots appear in the leaves.

• The tips of the leaves curl up radically and whole sections of the leaves begin to rot. The leaves keep on curling and ultimately fall off.

Solutions for a deficiency

• In case the EC in the substrate or potting mix is high, you can rinse with water.

• Add potassium yourself, either in inorganic form: Dissolve 5 - 10 grams of potassium nitrate in 10 litres of water. In acidic potting mixes, you can add potassium bicarbonate or potassium hydroxide (5ml in 10 litres of water).

• Add potassium in organic form:

• Add a water solution of wood ash, chicken manure or slurry of manure (be careful not to burn the roots). Extracts of the grape family also contain a lot of potassium.

• Potassium is absorbed quickly and easily by the plant. In a hydroponic system results get visible within several days. Potassium supplementation by leaf fertilisation is not recommended.

• Too much potassium will cause salt damage, calcium and magnesium deficiencies and acidification of the root environment!

• Too little, or the wrong type of fertiliser.

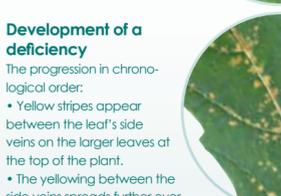
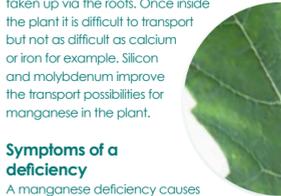
• Growing in potassium-fixed potting mixes.

• An excess of sodium (kitchen salt) in the root environment, as sodium slows down potassium intake.

Manganese

About manganese in short

Manganese is an essential trace element for all plants. Manganese acts as an activator for different enzyme reactions in the plant, for example in water-splitting during photosynthesis, the synthesis of amino acids and proteins and the build up of plant cell membranes and chloroplasts. Manganese is generally taken up via the roots. Once inside the plant it is difficult to transport but not as difficult as calcium or iron for example. Silicon and molybdenum improve the transport possibilities for manganese in the plant.



Symptoms of a deficiency
A manganese deficiency causes different physiological changes in the plant due to a decrease in protein production. Amongst others, this causes less nitrate to be fixed in the plant, which can lead to dangerously high levels of nitrate. Additionally, a lot of chemical reactions in plant cells slow down which may result in a build up of organic acids.

Development of a deficiency
The progression in chronological order:

• Yellow stripes appear between the leaf's side veins on the larger leaves at the top of the plant.

• The yellowing between the side veins spreads further over the leaf and small, yellow/brown necrotic spots can form.

• The final result is a small plant (-10%) with minimum fruit/flower production.

Solutions to resolve a deficiency
• Check the medium's pH when the first symptoms are noticed. High pH values mean that there is less manganese available for the plant. By lowering the pH of the nutrition (pH min [down]) the medium's pH can be lowered to 5.0-5.5.

• Low substrate temperature can be the cause of reduced manganese absorption. If a deficiency is noticed, check that the substrate temperature is sufficiently high (20-25 °C) during the day.

• Using products that contain trace elements (Tracemix) may also help. A manganese deficiency is usually not a problem on its own. To facilitate manganese transportation in the plant, molybdenum is needed. Thus, the problem may well be a molybdenum deficiency. High levels of phosphorus may also result in a reduced availability of trace elements like zinc, copper and (of course) manganese. CANNA advises to use a mix of all needed trace elements. Trace elements can be given to the plant both in the feeding and by spraying the leaves. Spray the plant at the end of the day and spray daily with water after spraying to prevent burning.

• The yellowing between the side veins spreads further over the leaf and small, yellow/brown necrotic spots can form.

• The final result is a small plant (-10%) with minimum fruit/flower production.

Excess Manganese!
When there are high concentrations, manganese precipitates into manganese oxide (MnO2 or black manganese) which causes yellow-brown spots on the leaves. Initially, small spots will appear along the main and side veins of the leaf, following this the spots will spread out from the veins. Excess manganese can be a result of a low pH in the substrate (<5.0), this can be corrected with pH plus (up). Oxygen deficiency in the root environment can also cause excess manganese. A substrate that is too wet can be a cause.

Reasons for a deficiency
In practice, the most common reason is that the pH in the substrate is too high. Like iron, manganese is easily dissolved at a low pH value in the substrate. If the pH is too low, a risk of excess manganese may occur. At high pH values manganese precipitates into

• Green/yellow chlorosis, from inside to the outside in the younger leaves and in the growth shoots. The veins remain mostly green.

• Continued yellowing of the leaves to sometimes almost white. Also, large leaves turn yellow. This inhibits growth.

• In serious cases the leaves show necrosis, and the plant's growth and flowering are inhibited.