

# First aid for deficiencies

# Calcium

What is it and what does it do? Calcium 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 fertilizer such as a Calcium nitrate solution.



# Phosphorus

What can you see?

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

## What is it and what does it do?

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



#### can you do?

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

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# 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 can you see?

• Yellowing leaves.

Purple stalks.

Leaves fall of.

What is it and what does it do? Nitrogen is a component of enzymes and is therefore involved in all enzyme

the plant's metabolism.

reactions and plays an active role in

What can you do? Raise EC of the feeding or add extra nitrogen.

# CANNA Research Laboratories

# 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

What can you see? Yellow stripes appear between the leaf's side veins.

> What can you do? elements.





# CANNA esearch Laboratorie

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 (cannatalk.com) and the website www.cannagardening.com.

# First aid for deficiencies

www.cannagardening.com

# 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 ransportation systems at their dis posal: the xylem vessels and the sieve vessels. Most nutrients can be transported via ooth systems, however, for Calcium this is not pos sible. Since Calcium can be transported almost exclusively via the xylem vessels, it is an element the deposes of little mobility with in the plant. It is, therefore, im portant that a sufficient amou of Calcium is always availa in the root environment, so that it will be continuously available for absorption by the plant.

#### Symptoms of a deficiency

The older, larger leaves jus above the bottommost or will show the first symptoms. low/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 ar smaller than normal and do not close.

#### Development of a deficiency

The symptoms often appear quickly; within one or two weeks of the first spo 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 he 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, he more serious the symptoms

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

#### **Reasons for a** deficiency

Culture on Calcium fixing potting mix An excessive amount of Ammonium, Potassium, Maanesium and or Sodium in the root environment. The absorption is curbed mostly by Ammonium and least by Sodium Problems with the vaporation caused by an excessively high EC value or by excessively high or low relative humidity.

### Solutions for a deficiency

• If the EC value of the substrate or the potting mix is too high, it can be easily rinsed out with pure and if necesary acidified water. Additional Calcium can be applied through the nutrient solution by means of liquid lime fertilizers 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

For your information: Be careful with fertilizers containing chloride.

#### About Phosphorus in short

Phosphorus plays an important role for all Due to the low concentrations in which living organisms and is an essential nutrient phosphate appears in nature, the affinity 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 otassium • The growth in height, and the development of the plant's side shoots are

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

The purple/black necroses expand to the leaf's stem. The leaf turns, curls considerably and dies off.

- The dead leaves are curled and shrivelled, have a typical ochre purple color and fall off
- The plant flowers fully, but the yield will e minimal



# Phosphorus



#### Reasons for a deficiency

of plant cells for Phosphorus allows easy absorption through the whole root. Therefore, shortages do not happen very often, except whe

• The growing medium has a too high H (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 car not be absorbed any more.

#### olutions for a deficiency

Always use inorganic phosphates as these are easy to absorb. Also alway mix the phosphate fertilizer 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.

# Magnesiun

#### About Magnesium in short

Agnesium is an indispensable element for - amongst others - plants. In plants, it epresents a building block for chlorophyll (leaf green), and therefore, it is essential or photosynthesis. At the same time lagnesium plays an important role i he energy transfer. Together with Calcium, it is also a component of tap water, influencina vater hardness. Inorganic Agnesium fertilizers are produced using the same bases that are used to produce Potassium fertilers.

#### Symptoms of a deficiency

When there is a shortage, the af green in the medium-ol eaves under the flowering top will be broken up, and the Magnesium will be transported into the oung parts of the plant. his breakdown is visible s rusty brown spots and/ or vague, cloudy, yellow pots between the veins. A slight nortage of Magnesium hardly affects flowering, although the levelopment of the flowers make the deficiency mptoms worse.

#### Development of a deficiency

Signs of a deficiency first appear around the 4th-6th eek. Small, rusty brown spots nd/or cloudy yellow flecks appear of the plant).

The color of the young leaves and the uit development are not affected.

- n the leaves increase.
- The symptoms spread out over the hole plant, which looks ill. When the nortage becomes acute, the younger aves are also affected and the flower oduction will be reduced.

#### **Reasons for a deficiency**

The Magnesium deficiency can occur because uptake is inhibited because of A very wet, cold and/or acidic root environmer

• A high quantity of potassium, Ammonia and/or Calcium (for instance high concentrations of Calcium carbonate

> n drinking water, or clay potting mixes rich in Calcium) in cor parison with the quantity of Magnesium.

> > • A limited root system and neavy plant demands. A high EC in the growin medium, which hinders evaporation.

#### Solutions for a deficiency

When a shortage is diagnosed the best thing to do is to spra with a 2% solution of Epsor salts.

• Fertilization via the roots norganic: Epsom salts or vdroponics or Kieserite Magnesium sulphate mono hydrate). Organic: compos ted turkey or cow manure.

#### Recoverv

Rectify the possible causes: In potting mixes, when the pH is too low (less than 5), use Magnesium containing Calcium fertilizers. In hydro emporarily apply a nutrient solution with a higher pH (6.5). When the EC is too igh, rinse and/or temporarily feed with drinking water only.

When growing indoors, keep the the middle-aged leaves (under the top root temperature between 20 - 25 degrees Celsius. A little extra Magnesium is not particularly harmful. When growing in potting mixes, excessive quantities of Magnesium The size and number of rusty brown spots do not appear quickly. Too much Magnesium inhibits the uptake of Calcium, and the plant displays general symptoms of a excess of salts; stunted growth, and darkcolored vegetation.

#### About Iron in shor

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 contain to little Iron, but it is possible hat forms of Iron that co be absorbed by the pla are lacking. The absorbency of Iron is strongly dependent on the pH. Usually, there is sufficien Iron present in absorbable form in acidic potting mixe

#### Symptoms of a deficiency

Iron deficiency can occ during periods of heavy growth or high plant stress and is characterized by a strong yellowing of the young leaves and the arowth shoots betwee the veins. This occurs chiefly because Iron is not mobile in the plant. The young leaves car not draw any Iron from the older leaves. With a seriou Iron shortage, the older leaves and the smaller veins in the leaf can also turn vellow.

#### Development of a deficiencv

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

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

Iron

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

- The root environment contains a lot of zinc and/or managese
- 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

• There is too much light on the nutrition tank; light

promotes the growth of algae Algae also use up the Iron and oreak down Iron chelates.

#### Solutions for a deficiency

• Lower the pH. • Iron chelates can be added to the substrate. • Drainage can be improved, or the ground temperature can be increased. A leaf nutrient with Iron chelates can possibly be applied. If a good fertilizer is used with hydroponic growing, an Iron deficiency is almost out of the question. The best thing you can do is to spray the plants with a watery solution of EDDHA (max. 0.4 grams per gallon) or EDTA chelates (ma 2 grams per gallon).











## Nitrogen

#### About Nitroaen in short

litrogen is one of the important elements a plant needs. It is an important part of proteins, chlorophyll, vitamins, hormone nd DNA. Because it is a component of enzymes, Nitroaen is involved in all enzyme eactions and plays an active role ir the plant's metabolism. Nitroger mainly absorbed by the plant n the form of nitrate and ammonium. It can also be absorbed via small organic molecules. It is important that the balance between nitrate and amnonium is correct in the feeding otherwise the pH in the rhizosphere (environment nmediately surrounding the oots) will become too high or low. Plants with nitrate as thei 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 pos ive influence on the plant's rowth. The plant gets bigger leaves, more branches and the vegetative period s extended.

#### symptoms of a deficiency

talks will turn purple and eaves will turn yellow and finally

#### evelopment of a deficiency

Quickly followed by larger leaves in the iddle and top parts of the plant. The plant is a lighter color as a whole. arger leaves in the lower part of the int turn light green. The leaf stalks of ne smaller leaves now also turn purple pical vertical purple stripes appear in

• 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 shorter 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 remair green longer but they are a ot less green than at normal itrogen levels. Forced flowering starts

ind there is substantial leat loss, Substantial reduction

#### Reasons for a eficiency

ciency can be caused by inprrect feeding or giving feedng that contains insufficient nutrient elements. Substrate that contain a lot of fresh rganic material can cause Nitrogen deficiency because micro-organisms bind the Nitrogen. A lot of Nitrogen can be bound, particularly in the first weeks: this s released later but it is generally too late

#### Solutions to resolve a deficiency

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

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 Add Nitrogen yourself to the feeding solution by using urea, blood meal, semi-liquid manure or by using a special "mononutrient" 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 burnina.

# Potassium

#### About Potassium in short

It is necessary for all activities having to do In case the EC in the substrate or potting with water transport and the opening and mix is high, you can rinse with water. closina of the stomata. Potassium takes care of the strength and the quality of the ic form: Dissolve 5 – 10 grams of Potassium plant and controls countless other processes such as the carbohydrate system.

#### Symptoms of a deficiency

Evaporation is reduced if there is a shortage of Pc tassium. 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 deficiencv

• Tips of the vounger leaves show grey edges. • Leaves turn yellow from the edge in the direction of the veins and rustv colored 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. • An extreme shortage

produces meagre, unhealthy-looking plan<sup>4</sup> with strongly reduced flowering.

#### Reasons for a deficiency

- Too little, or the wrong type of
- fertilizer
- Growing in Potassium-fixed potting
- An excess of sodium (kitchen salt) in the pot environment, as sodium slows down tassium intak

#### Solutions for a deficiency

 Add Potassium yourself, either in inorgan nitrate in 2.5 gallons of water. In acidic potting mixes, you can add Potassium bicarbonate or Potassium hydroxide (5m

> in 2.5 gallons 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

#### For your information

 Potassium is absorbed auickl and easily by the plant. In a hydroponic system results aet visible within severa days. Potassium supplementation by leaf fertilization is not recommended. Too much Potassium will cause salt damage, Calcium and Magnesium deficiencies and acidification of the root envi-

#### About Manganese in short

Manganese is an essential trace element for be taken up by the plant which can cause all plants. Manganese acts as an activator for different enzyme reactions in the plant, for ex ample in water-splitting during photosynthesis, the synthesis of amino acids and proteins and the build up of plant cell membranes nd chloroplasts. Manganese is generally aken up via the roots. Once inside he plant it is difficult to transport out not as difficult as Calcium or ilon for example. Silicon and molvbdenum improve the transport possibilities for Manganese in the plant.

#### symptoms of a deficiency

A Manganese deficiency causes different physiological changes in e plant due to a decrease in rotein production. Amongst others, this causes less nitrate o be fixed in the plant. vhich can lead to danger ously high levels of nitrate. Additionally, a lot of chemial reactions in plant cells ow down which may result in build up of organic acids.

#### Development of a deficiency

ne proaression in chrono ogical order:

Yellow stripes appear between the leaf's side eins on the larger leaves he top of the plant.

The yellowing between the de veins spreads further over he leaf and small, vellow/browr necrotic spots can form.

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

#### easons for a deficiency

practice, the most common reason is the he pH in the substrate is too high. Like Iron, anaanese is easily dissolved at a low pH alue in the substrate. If the pH is too low, a isk of excess Manganese may occur. At high H values Manganese precipitates into



Potassium.

ronment!



## Manganes

deficiency.

 Check the medium's pH when the first symptoms are noticed. High pH values mear that there is less Manganese available for the plant. By lowering the pH of the nutritio (pH minus (down)) the medium' pH can be lowered to 5.0 - 5.5 Low substrate temperature can be the cause of reduced anganese absorption. If a

Manganese oxide (MnO2) which cannot

#### Solutions for a deficiency

leficiency is noticed, check that the substrate temperatur is sufficiently high (68 - 77 °C) during the day.

 Using products that contain trace elements may also help. A Manganese deficiency is usually not a problem on its own. To facilitate Manaa

nese transportation in the plan molybdenum is needed. Thus ne problem may well be a nolybdenum deficiency. High levels of Phosphorus may also result in a reduced availability of trace elements like zinc, cop oer and (of course) Manganese CANNA advises to use a mix of all eeded trace elements. Trace ele

> ments 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 ourning.

#### **Excess Manganese!**

When there are high concentre Manganese precipitates into Manganese oxide (MnO2 or black Manganese) which causes yellow-brown spots on the leaves. Initially, small spots will appear along the mai 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 pl plus (up). Oxvaen deficiency in the root environment can also cause excess Manganese A substrate that is too wet can be a cause.

