Deficiency symptoms and fertilisation in asparagus cultivation

Foreword Limgroup

Limgroup is delighted to offer you this practically-oriented book. Based on photographs and practical descriptions, this book helps you recognise nutrient deficiencies in asparagus cultivation.
This book is therefore a practical aid and not a scientific publication.
We would like to warmly thank Dr agr. Carmen Feller (Leibnitz-Institute of vegetable and ornamental plant Großbeeren/Erfurt e.V.). She was indispensable in the compilation of this book.
We hope that this book will support you in your daily asparagus cultivation.

For more information about our varieties you can contact our product specialists or visit our website www.limgroup.eu

Limgroup B.V.

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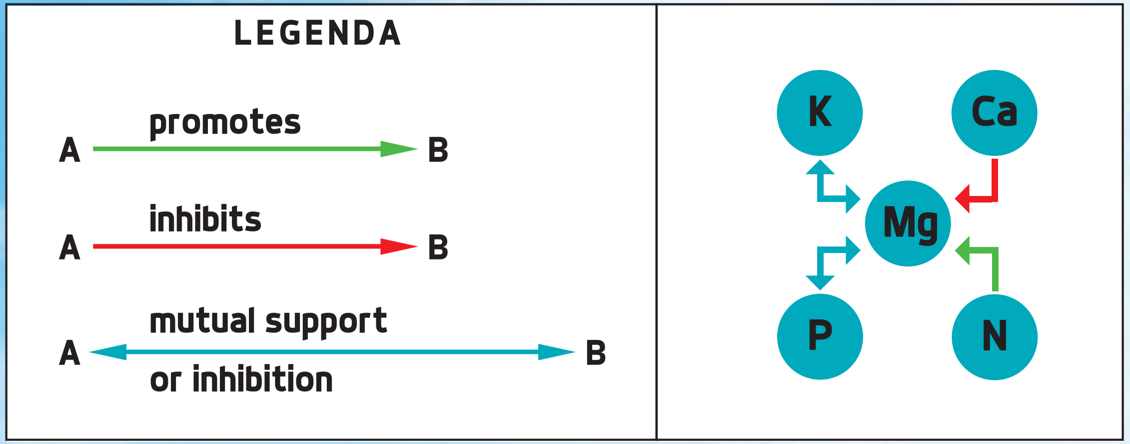
Content

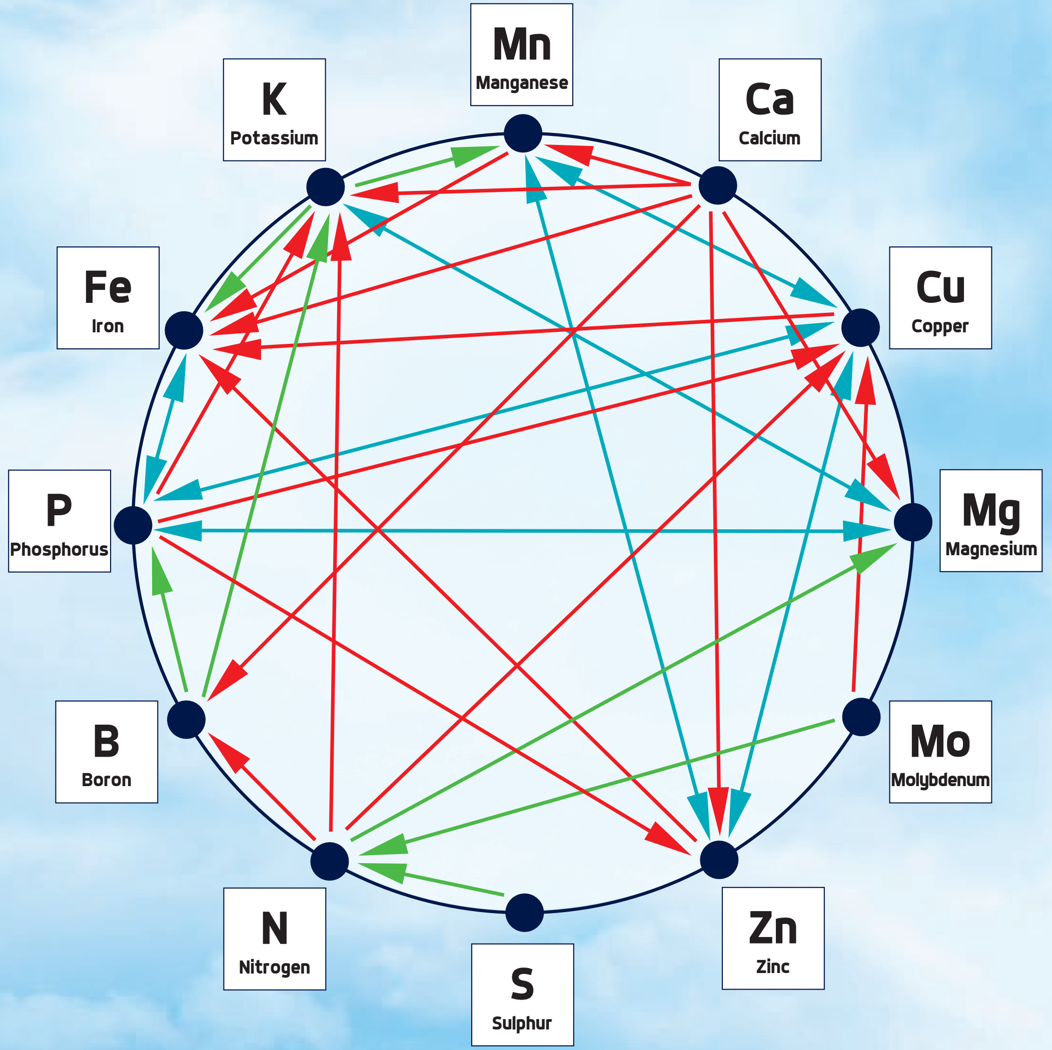
N Nitrogen	P Phosphorus	K Potassium			Mg Magnesium	Ca Calcium	S Sulphur
Primary macronutrients					Secondary macronutrients		
Zn Zinc	Mn Manganese	B Boron	Fe Iron	Mo Molybdenum	Cu Copper	Cl Chlorine	Ni Nickel
Micronutrients							
C Carbon	H Hydrogen	O Oxygen				Na Sodium	Se Selenium
Non-mineral elements						+ Beneficial elements	

Introduction

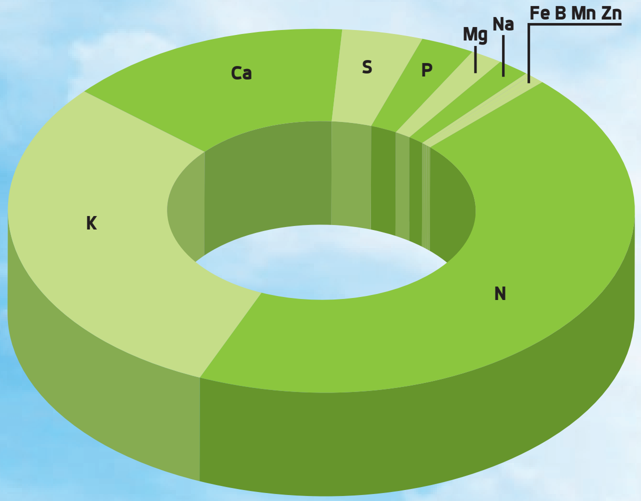
There are at least 17 essential elements for a healthy asparagus plant. Without these elements, the plant cannot grow. To exploit the maximum the potential of the plants, these elements must be available in the correct amounts. Here, Liebig's law of the minimum applies, whereby the element with the lowest availability in relation to the others elements leads to reductions in yield. Even if all the other elements are available in sufficient quantities. Therefore, plant nutrition is a balancing act between supply and demand. The plant health can also be influenced by an unbalanced nutrient supply. Timely recognition of deficiencies is essential to be able to restore the balance.

Mulder's card

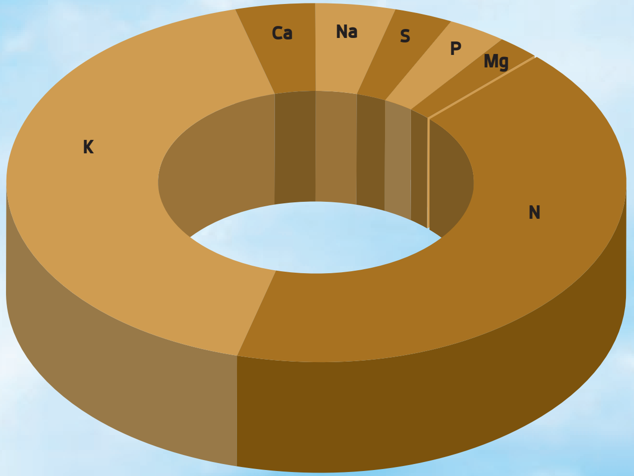




Nutrient contents fern



Nutrient contents storage root

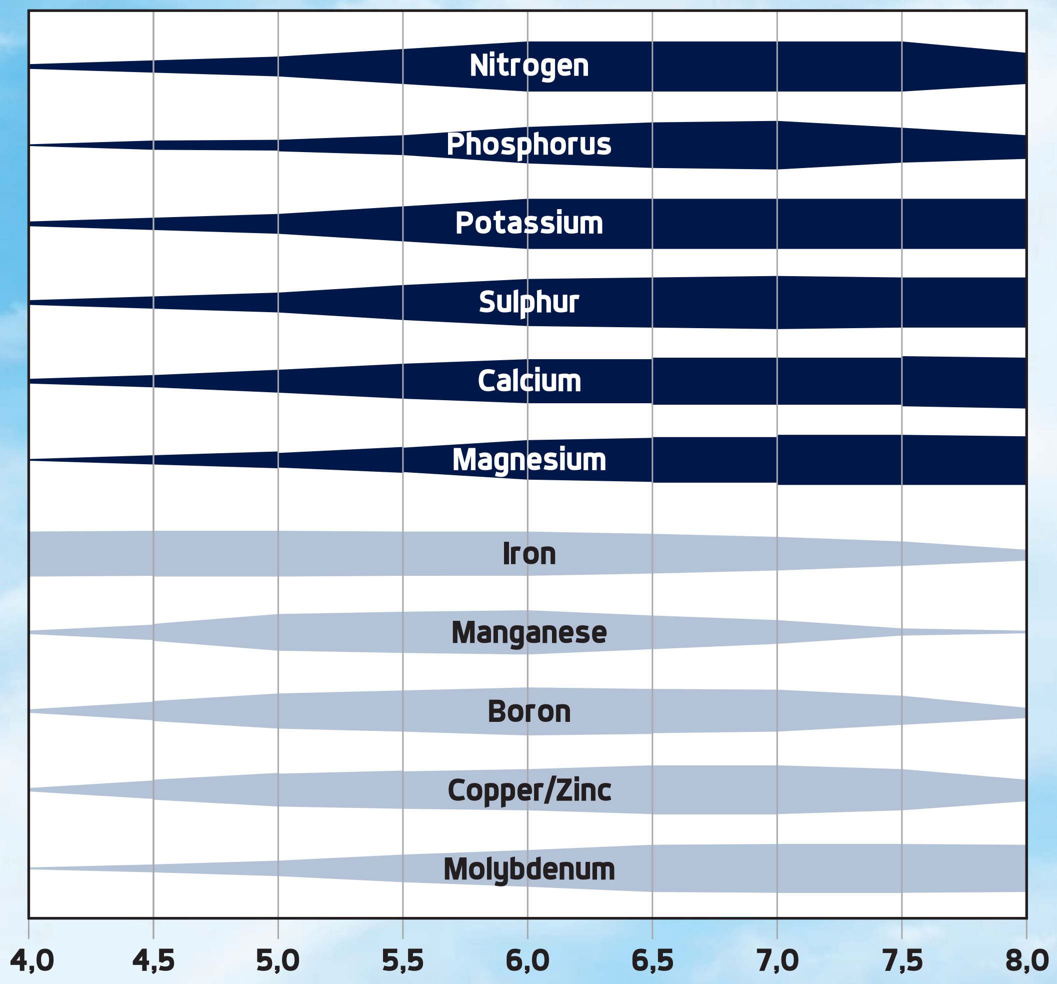


Nutrient demand

The nutrient supply to asparagus should be balanced and adjusted to the plant's requirements. In the first year after planting, the basis for sufficient rhizome and storage root formation is laid and with it the prerequisites for the coming yield are created. The highest nutrient demand is present predominantly in the leaf growth phase up to the end of shoot development and phylloclade formation. A clear lack of only one nutrient leads to signs of deficiency and reduction in growth.

The ratio of macro- and micronutrients in the fully formed leafs in the aerial growth (green) and the ratio of macronutrients in the storage root (brown) show considerable similarities. This relationship varies throughout the course of the seasonal development. Thus, the nitrogen and potassium content in the foliage dry matter drops considerably towards the end of vegetation, while the calcium content increases.

Nutrient availability as a function of the pH value



Availability of nutrients in the soil

The nutrients in the soil are present in various types of bonds

- Ionic (NH_4^+, NO_3^-, K^+, PO_4^{3-}),
- Precipitates or adsorbed (aluminium or iron phosphates, ammonium and potassium bound to clay minerals) and
- Organically bound (in the organic soil substance, e.g. nitrogen in proteins, phosphorus in ATP, DNA, etc.)

To estimate the nutrient availability and the pH values of the soil, information concerning the nutrient content is required. For nitrogen, this soil analysis of the mineral nitrogen content should take place once a year at the prevailing time of fertilisation requirement in the well-rooted layer. For phosphorus, potassium, magnesium and the pH value, soil analyses should be performed at two- to three-year intervals. Soil analysis is particularly significant in the year when the asparagus fields are being prepared. The analysis of soil samples must show the current reserve in the soil and the nutrient availability. In the preparatory year, the micronutrient content and availability should also be analysed.

The pH-value of the soil is crucial for the availability of the nutrients. The optimal pH-value for asparagus in sandy soil is 5.9, and in clay soils 6.5 – 7.0. If the values from the soil analysis for the individual nutrients and the pH-value are below the target value, then specific fertilisation is necessary.

Example evaluation of a soil analysis in the preparatory year:

Major elements	Unit	Result	Target range	very low	low	good	high	very high
Total nitrogen	mg N/kg	1440						
C/N-ratio		16	13 -17					
N-supplementar supply	kg N/ha	59	93-147					
Total sulphur	mg S/kg	270						
C/S-ratio		84	50 -75					
S-supplementar supply	kg S/ha	11	20-30					
P-available	mg P/kg	1,4	1,3 -2,6					
P-reserve	mg P_2O_5/100g	64	30-46					
K-available	mg K/kg	73	70-110					
K-reserve	mmol+/kg	2,9	2,0-3,0					
Ca-available	kg Ca/ha	107	240-559					
Ca-reserve	kg Ca/ha	3620	2600-3905					
Mg-available	mg Mg/kg	59	50-85					
Na-reserve	mg Na/kg	< 6	35-50					

Trace elements	Unit	Result	Target range	very low	low	good	high	very high
Si-available	µg Si/kg	4750	6000-32000					
Fe-available	µg Fe/kg	< 2020	2500-4500					
Zn-available	µg Zn/kg	800	500-750					
Mn-available	µg Mn/kg	2500	3200-5000					
Cu-available	µg Cu/kg	30	40-65					
Co-available	µg Co/kg	2,5	25-50					
B-available	µg B/kg	140	129-175					
Mo-available	µg Mo/kg	< 4	100-5000					
Se-available	µg Se/kg	2,1	3,5 - 4,5					

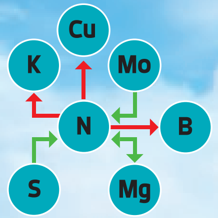
The soil analysis

The evaluation of the soil analysis must provide information about the levels of major and trace elements present in the soil, both for the nutrient levels directly available to the plants as well as for the soil reserves. Furthermore, the pH-value and the levels of organic substances should be determined.
The sample should be taken from the soil horizon penetrable by the roots. This is essential for determining the condition of the subsoil. For a pooled sample, at least 20 spot samples should be taken distributed over the surface. Sub-areas with varying soil conditions (hills, sinkholes) should be sampled and assessed separately.

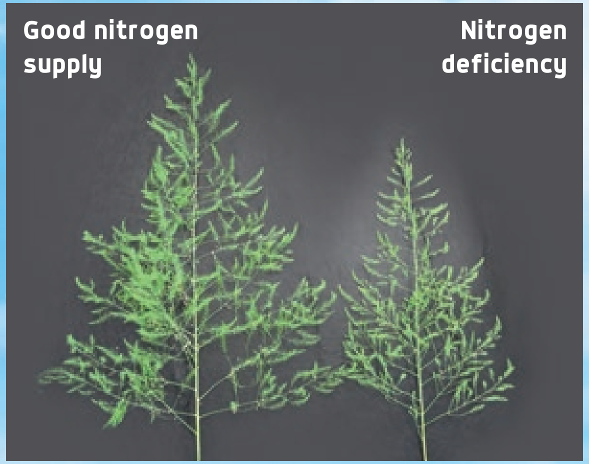
physical	Unit	Result	Target range	very low	low	good	high	very high
Degree of acidity	pH	5,6	5,6-6,1					
Organic substance	%	3,9						
C inorganic	%	0,05						
Calcium bicarbonate	%	< 0,2	2,0-3,0					
Clay	%	3						
Slit	%	14						
Sand	%	79						
Clay-humus (KAK)	mmol+/kg	64	< 56					
(KAK)-proportion	%	100	< 95					

biological	Unit	Result	Target range	very low	low	good	high	very high
Soil organisms	mg N/kg	29	60-80					

German reference figures								
P-CAL	mg P_2O_5/100g	31						
K-CAL	mg K_2O/100g	32						
Magnesium	mg Mg/100g	6						



Nitrogen


Good nitrogen supply | Nitrogen deficiency


Brighten fern


Purple coloring at branching

Significance (Role in plant metabolism)

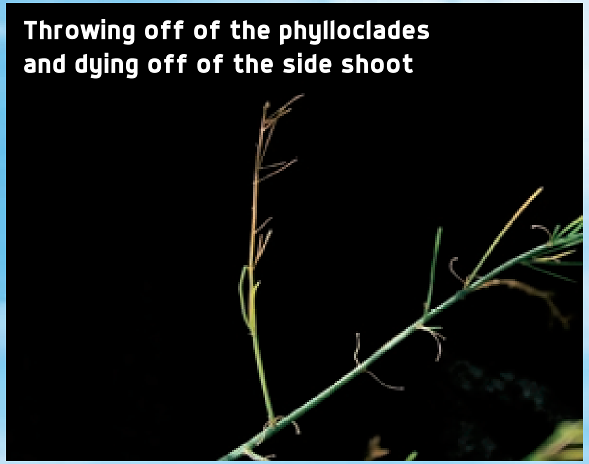
Nitrogen is an important building block of chlorophyll and is therefore significantly involved in photosynthesis. As an essential element in the structure of amino acids, proteins, nucleic acids and vitamins, nitrogen influences all the direct growth and yield-formation processes. As a component of important plant enzymes, nitrogen supports the formation of hormones, gibberellins and cytokinines, and therefore indirectly all the growth processes. Nitrogen is taken up as nitrate (NO_3^-) or as ammonium (NH_4^+). The majority of the mineral fertilisers are based on these two forms of nitrogen.

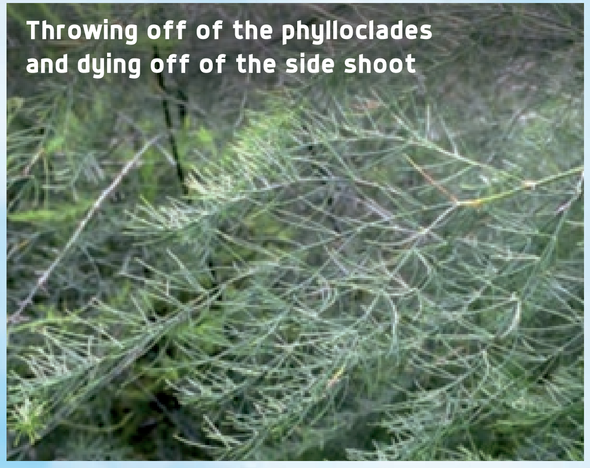
Deficiency symptoms

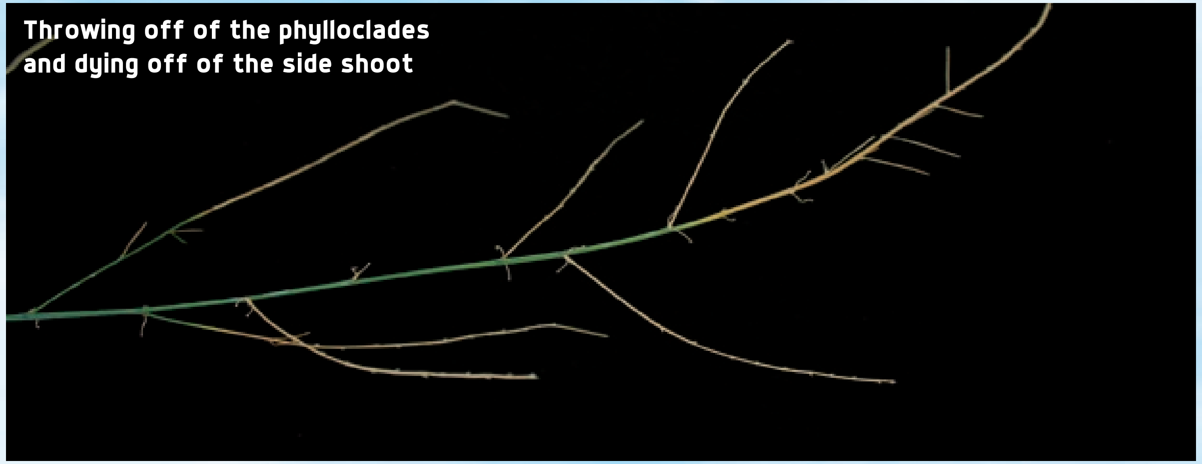
Specific nitrogen deficiency symptoms are difficult to describe. Characteristics are an overall reduction in growth, known as “spindly growth” and an almost uniform, light colouration, which begins in the older shoots. The number of phylloclades in significantly reduced. Light purple-red colouration is sometimes seen in the areas of branching to secondary shoots.

Special features

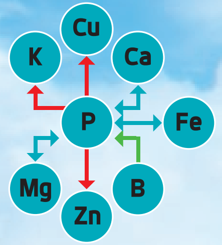
The primary nitrogen requirement is in the fern development phase and therefore fertilisation should take place after harvesting. In the first year after planting, the root system is built up. At the end of the third year, up to 400 kg /ha can be stored in it. From the fourth year, this storage contributes to the required nitrogen supply, which can be reduced from this year onwards.
Nitrogen uptake is impaired by excess phosphate, and ammonium uptake by excess calcium, magnesium and potassium.
The nitrogen in the soil is very mobile. An oversupply of nitrogen can lead to impaired quality, such as open heads or an extreme scoring of the spears during harvesting. Crops with excess nitrogen have a short storage life. A high nitrogen supply at the time of ripening beginning can cause a delay and lead to a reduction in reserve carbon storage.


Throwing off of the phylloclades and dying off of the side shoot


Throwing off of the phylloclades and dying off of the side shoot


Throwing off of the phylloclades and dying off of the side shoot

P Phosphorus



Significance (Role in plant metabolism)

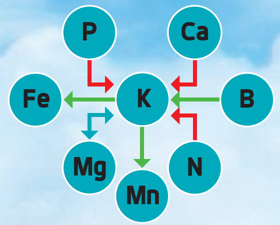
Phosphorus is an essential building block for nucleic acids (DNA, RNA), basis for the energy transfer ATP (adenosine triphosphate), and it promotes root development. The availability of sufficient P is especially important in the first developmental stages of the seedlings to ensure good crop establishment. Deficiencies cause disturbance of the whole metabolism, as energy transfer does not function properly. Phosphorus is taken up by the plant as orthophosphate (HPO_4^{2-} or $H_2PO_4^-$). Phosphorus is also present in fertiliser as P_2O_5.

Deficiency symptoms

Phosphorus deficiency leads to dying off of the upper side shoots on older shoots and to dying off and shedding of the phylloclades. The shedding of the phylloclades occurs very quickly and partly already when they are still green. The shoots tend to be blue-green in colour. The new shoots are stunted – similarly to calcium deficiency, as the whole metabolism is disturbed. Phosphorus is very mobile in the plant and when there is a deficiency, it is transferred from the older plant parts to the growth zones.

Special features

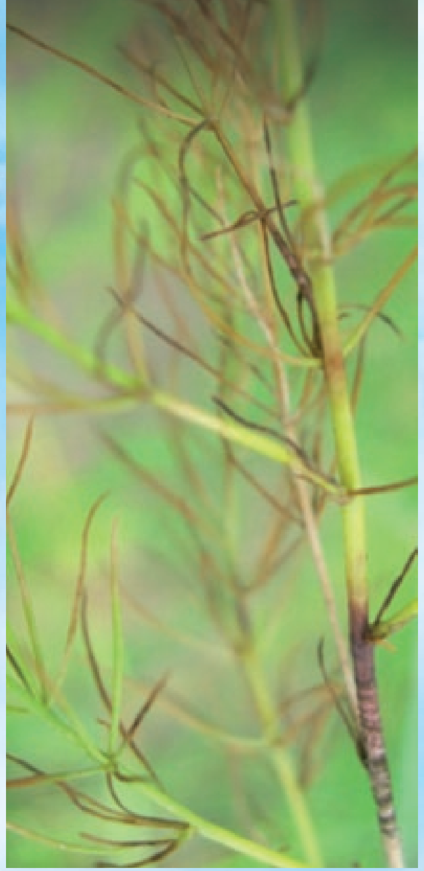
The phosphorus availability in the soil is strongly dependent on the pH-value. The best supplementary supply takes place at a pH between 6 and 7. Aluminium and iron phosphates are formed with increasing acidification of the soil. In early spring, at low soil temperatures, there can also be P deficiencies in the plants even with a sufficient soil reserve, as still no release from the soil reserve takes place. With increasing soil temperatures, the phosphate is available to the plant again.



K Potassium

Chlorosis of the phylloclade

Brown coloring and dying off the side shoot



phylloclade tips turn yellowish brown

Significance (Role in plant metabolism)

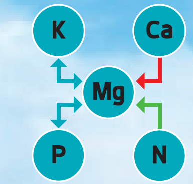
Potassium plays an important role in stomata regulation, improves water usage and reduces drought stress. Potassium promotes the formation of the supporting tissue of the corresponding cell structures. Furthermore, potassium is involved in the formation of carbohydrates, such as sugar and starch, and in the activation of a number of enzymes. Potassium makes a crucial contribution towards the transport of reserve carbohydrates and their storage in the rhizome.
Potassium strengthens the natural resistance of the plant to diseases, pests, frost, and increased the drought stress resistance. Potassium enhances the quality characteristics of the harvested asparagus.
It is taken up as K^+. Potassium is present in fertiliser as K_2O_5

Deficiency symptoms

Potassium deficiency is initially visible in the older shoots. Chlorosis forms in the side shoots; the phylloclade tips become yellow-brown in colour. In an advanced deficiency, the phylloclades die off and later also individual shoots. Unlike with magnesium deficiency, with a potassium deficiency the phylloclade tips have a somewhat yellow-brown colour from the start, and rapidly all the phylloclades of the side shoots are affected. The death of entire shoot is not as pronounced as in magnesium deficiency. During the harvest, a structural deficit is seen as low stalk diameter and poor quality.

Special features

It is very difficult to differentiate between a potassium and magnesium deficiency using the symptoms and it should be clarified using analyses. K-uptake by the plant is dependent on the K/Mg ratio.
An optimal K to Mg ratio is 1:2.
The potassium content of the soil is in the first instance dependent on the soil type. An increased risk of leaching can pose a problem in light soils.



Mg Magnesium


Chlorosis and fern whitening


Dead phylloclades on the side shoot


Yellow coloring of the phylloclades

Significance (Role in plant metabolism)

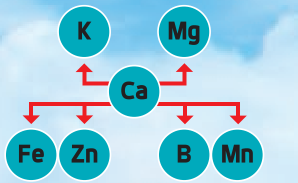
Magnesium is an important building block of chlorophyll and is therefore significantly involved in photosynthesis. It is partly responsible for cell wall stability (as a component of pectic substances), supports the synthesis and storage of important plant components and has an activating effect on various enzymes. Magnesium has hydrating properties in the plant and thereby influences the water balance. As a component of phytin, it represents a low-energy phosphate store. Magnesium is present in fertilisers as MgO and is taken up by the plants as the Mg^{2+} ion.

Deficiency symptoms

Magnesium deficiency begins with chlorosis in the older shoots. The phylloclades are partly light-green to yellow, whereby the outermost phylloclade tip often remains green. Bit by bit the phylloclades of the older shoots die off, but remain on the side shoots, which remain green for a while. In the case of severe deficiency, the older shoots die off completely. The very good mobility of magnesium in the plant is documented by the newer green shoots, which are often without symptoms. On the whole, root growth is also considerably impaired. The root mass in the trial after two years was around 60 % compared with the control, and the amount of reserve carbon was reduced by 35 %.

Special features

If the phylloclade tips of youngest asparagus shoots are also light-green to yellow, then there is more likely a physiological disturbance and not a magnesium deficiency.
In low sorption soils with low pH-values, increased leaching must be expected. The Mg-uptake by the plant is negatively influenced by a wide K/Mg 1:2 and Ca/Mg (sand >3:1 and loam >7:1) ratio as well as a low pH-value of the soil.



Calcium


Walking stick disease


Newly driven shoots die off


Reduced storage root formation.

Significance (Role in plant metabolism)

Calcium is involved in the cell wall structure and stabilisation of the cell membranes. With a calcium deficiency, root growth is considerably impaired. Calcium is essential for plant stability and quality. It is taken up as Ca^{2+} by the plant and is usually present in fertiliser as CaO. Ca^{2+} uptake can only take place through the tips of the hair-roots.

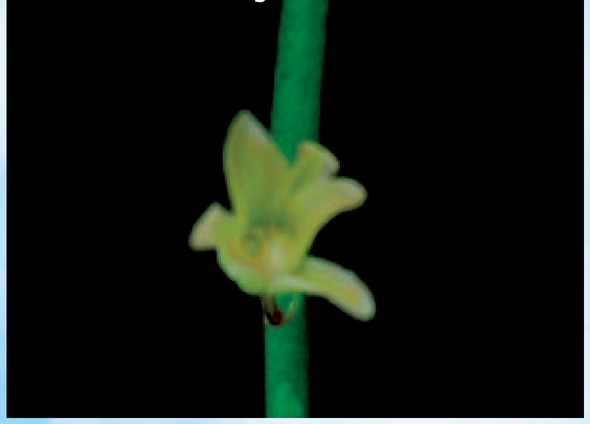
Deficiency symptoms

The so-called “walking stick disease” can be traced back to a calcium deficiency. The younger, sprouting shoots bend even before obvious shoot tip differentiation, wither and then completely die off. The plant constantly sends out new shoots, but they all die off. This leads to increased formation of fruit, even in pure male varieties, and the seeds are viable. Noticeable is the greatly reduced storage root formation, with root lengths of only three to five cm and as a result an extremely reduced root mass. The phylloclades are short and hard.

Special features

In male asparagus varieties with a lot of red fruits, one should check the available calcium content of the soil. Calcium cannot be mobilised out of the older tissues, and like magnesium cannot be transported via the phloem. Therefore, sufficient transpiration must be guaranteed in order to prevent a Ca deficiency. A calcium deficiency can also be generated by high levels of ammonia or potassium.


Rigid appearance of the plant


Different flowering


Light green phylloclades

S Sulphur

Significance (Role in plant metabolism)

Sulphur is involved in the formation of essential amino acids, proteins and the activation of many enzymes. A sulphur deficiency means also nitrogen is not properly utilised, and therefore this also promotes a nitrogen deficiency. Sulphur is indispensable for the production of the plant's own defence substances (phytoalexins, glutathione) and therefore all in all for strengthening the plant's own immune mechanisms. Promotes root development and strengthens the plant. Taken up by the plant as SO_4^{2-} from the soil and can also be resorbed via the foliage in the form of SO_2 from the air.

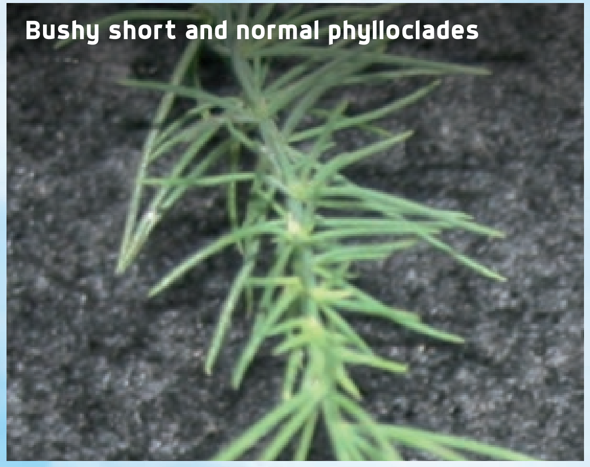
Deficiency symptoms

Sulphur deficiency is easily recognised as a lightening of the phylloclades to a very light green. The deficiency begins in the younger shoots, while the older shoots remain without symptoms. The entire appearance of the plants is very rigid; the side shoots and internodes are extremely shortened. With a severe sulphur deficiency, the flowers are also affected. These are considerably smaller and the six stamen are no longer orange-yellow, but instead are light-yellow to white or completely distorted.

Special features

In the past, up to the 1980s, the sulphur requirement of plants was often neglected, as SO_2 emissions originating from industry provided practically automatically the addition of sulphur. Since the implementation of air-purification measures, the sulphur requirements must be considered during fertilisation. Sulphur in the form of sulphate is severely at risk of leaching.


Compact growth


Bushy short and normal phylloclades


Short internodes

Zn Zinc

Significance (Role in plant metabolism)

Zinc plays an important role in protein formation, elongation and influences the indole-3-acetic acid among other things, which is important for regulating plant growth (extension and radial growth). Zinc is not very mobile within the plant, and a low zinc content in the plant favours fungal and viral diseases. The plant takes up zinc as Zn^{2+}.

Deficiency symptoms

Compressed and compact growth is characteristic of zinc deficiency. Besides a rather dark-green colour, shortened internodes on the younger shoots and an unusual formation of additional short phylloclades over a limited area are noticeable. The shoots are clearly shorted and very bushy.

Special features

The zinc availability is strongly influenced by the pH-value and the total zinc content. The availability of zinc decreases with increasing pH and is already very low at pH 6.
According to the latest findings, isolated phosphorus fertilisation can reduce the zinc availability and isolated zinc fertilisation, in return, can prevent phosphorus uptake.

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Manganese


Wilt with sufficient water supply


Young side shoot kniking of

Significance (Role in plant metabolism)

Manganese is involved in the formation of chloroplasts and many other enzymatic processes (lipid and carbohydrate synthesis) in the plant. Cell elongation is also disrupted through disturbance in the formation of lateral roots. Manganese is involved in protecting the cells from free radicals and splitting phosphate from organic phosphates. The plant takes up manganese as Mn^{2+}.

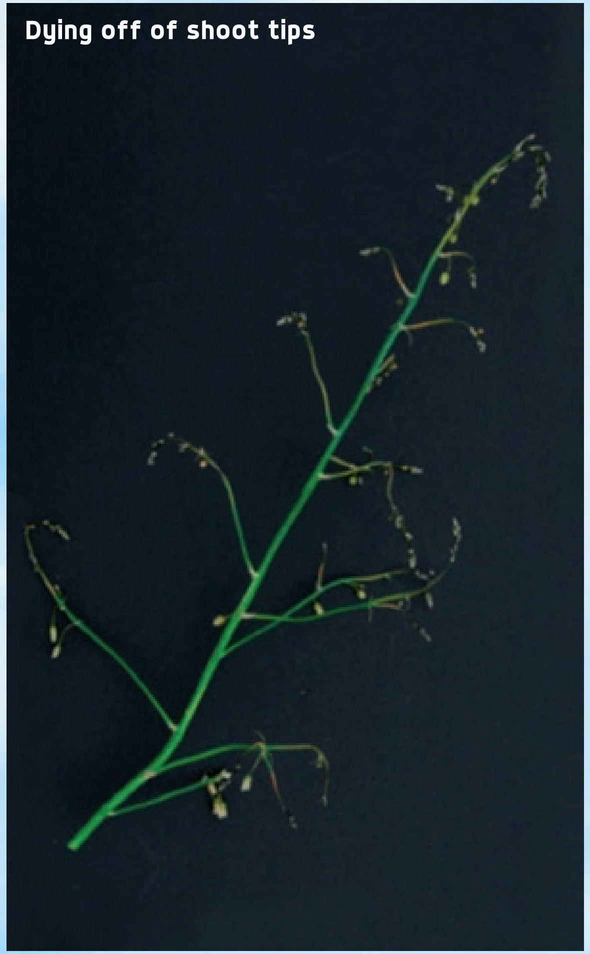
Deficiency symptoms

Manganese deficiency is a rare occurrence. A typical manganese deficiency symptom is observed as unusual “bending” of the young side shoots and wilting and withering of the phylloclades. The latter can certainly be traced back to a disturbance in the water balance through the lack of lateral roots. Manganese is very immobile in the plant.

Special features

The concentration of plant-available manganese ions increases as the pH-value and redox potential are reduced. Manganese in the soil promotes the availability of phosphorus and calcium. Manganese deficiency is more common in soils with a high pH of above 6, or a high humus content. Manganese is present in some fungicides.


Dry up young phylloclades


Dying off of shoot tips


Dehydrating phylloclades

B Boron

Significance (Role in plant metabolism)

Boron is an essential micronutrient and influences many processes in the plant metabolism. Boron is particularly important in the formation of cell wall-stabilising carbohydrates, improvement of the membrane function and production of substances. Boron promotes plant growth through its influence on cell division and improves flowering behaviour. Boron is primarily taken up as H_3BO_3 (boric oxide) but also as $H_2BO_3^-$ (borate).

Deficiency symptoms

A deficiency leads to dying off of the youngest shoot tips, as well as drying up of the younger phylloclades. Impaired water balance and the insufficient supply of assimilates are the cause of this. Root growth is restricted when there is a lack in boron.

Special features

Sand-rich soil tend to have low boron content. The boron availability is strongly influenced by the water content of the soil; less boron is taken up under dry conditions. Boron promotes the uptake of phosphorus and is severely at risk of leaching.

Fe Iron

Significance (Role in plant metabolism)
Iron is significantly involved in chlorophyll formation. As a component of cytochrome, iron is responsible for electron transfer in the chloroplasts and the mitochondria. Iron is taken up as Fe^{2+} or in the form of specific chelates and is transported into the cells as Fe^{3+}. It can only be taken up by the root tips.

Deficiency symptoms
An iron deficiency is seen as a reduction in the number of shoots and chlorosis in the young parts of the plant and phylloclades. Deficiency symptoms appear predominantly in younger cladodes.

Special features
Iron deficiency can occur due to a high pH-value or excessive phosphorus fertilisation. A high level of manganese in the soil interferes with iron uptake.

Na Sodium

Significance (Role in plant metabolism)
The amount of sodium in the asparagus roots, in the harvested spears and in the fern is relatively high. In the roots, for example, the content is even higher than that of phosphorus and magnesium. Asparagus belongs to the group of natrophilic crop types. Sodium promotes the formation of fructose, fructans (reserve carbohydrates) and their conversion to glucose. Furthermore, sodium regulates the osmotic pressure in the cells and leads to more efficient water utilisation. Sodium is taken up as Na^{+}.

Deficiency symptoms
Deficiency symptoms for asparagus are not described.

Special features
Sodium ions can partly activate the enzymes of the plant metabolism, which are also activated by potassium ions. That means they are exchangeable to a limited extent.

Cu Copper

Significance (Role in plant metabolism)
Copper in the plants is a component of many important enzymes, it improves photosynthesis performance and cell wall stability. Like with manganese, copper is involved in the binding of oxygen radicals. Copper is taken up as Cu^{2+}.

Deficiency symptoms
The occurrence of shorter and thicker shoots with stunted side shoots is described with copper deficiency. Also the dying off of the young parts of the plants.

Special features
Very humus-rich soil is often sensitive to copper deficiencies due to the incorporation of copper into the humus complexes. Heavy loam or clay soil is somewhat less sensitive. The mobility of copper in the soil is very limited.

Mo Molybdenum

Significance (Role in plant metabolism)
Molybdenum plays a central role in the nitrogen metabolism of the plant. As a component of a series of enzymes, for example nitrate reductase involved in nitrate reduction, it raises the protein content and its quality. Molybdenum is taken up as MoO_4^{-2} (molybdate).

Deficiency symptoms
With molybdenum deficiency, a course of senescence is described in the phylloclades, running from top to bottom. The phylloclades take on a yellow colour, especially those close to necrotic tips.

Special features
Molybdenum is only necessary in the smallest quantities. Therefore, the interval between shortage and excess is only short. Uptake is inhibited at the pH-value below 6.

Ni Nickel

Significance (Role in plant metabolism)
Nickel is a component of the enzymes required for the conversion of nitrogen.
Nickel is taken up as Ni^{2+}.

Deficiency symptoms
No typical deficiency symptoms are known for asparagus.

Special features
Nickel is only required in the smallest amounts. A deficiency is barely to be expected in asparagus.
Deficiencies can occur in peat soils.

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Cl Chlorine

Significance (Role in plant metabolism)
Like potassium, chlorine is predominantly required for osmoregulation and water balance in the plant. It is not incorporated into an organic structure, but is essential for the function of asparagine synthetase required or the formation of the amino acid asparagine. Chlorine is taken up as Cl^{-}.

Deficiency symptoms
A chlorine deficiency is very rare. No symptoms have been described in asparagus to date.

Special features
Chlorine is only required by the plant in very small amounts and is very mobile within the plant. Many fertilisers and a number of herbicides contain chlorine compounds. As a result, a chlorine excess can also quickly occur. Asparagus is relatively non-sensitive to chlorine. Where there is a very pronounced excess, the shoots/phylloclades become yellowish and can ultimately die off.

Yellow phylloclades at chlorine excess


Assessment of nutrient deficiency symptoms

The deficiency symptoms presented can be clear indications of severe shortage of the respective nutrient or nutrient combination and are seen in a variety of forms:

- Discolouration of the phylloclades
- Necrosis (dying off of parts of the plant)
- Crookedness
- Reduced growth, etc.

It is often not easy to assess these symptoms, as causes other than nutrient deficiency must also be taken into consideration and must be excluded in the ideal case, for example

- Phytopathogenic causes (fungi, pests).
- Environmental causes (intense radiation, high temperatures)
- Anthropogenic causes (herbicides and sprayed plant protectants, drift)
- Developmental condition of the plants

The deficiency of a nutrient can be brought about by the excessive supply of another nutrient. An excess can also lead to severe impaired quality.

Using soil and plant analyses, it must be determined whether there is indeed a nutrient deficiency. **Measurement is the key to knowledge.**

Fertiliser

Nutrient supply

Organic fertilisers

Organic fertilisers in the form of stable manure, compost or spent mushroom compost should be applied before replanting, to raise the humus content in the majority of sandy soil. Higher humus content correlates with increased yield.
Humus has a very important function in the soil. It stores water and can release this again during dry periods. The nutrients present in the soil are partly bound to humus complexes. In this way, the humus in the soil acts like a buffer. The humus content of a site varies considerably depending on the type of soil, the cultivation and the climatic conditions. 2 - 3% is the optimal humus content for asparagus culture. Improving the humus content is a long-term undertaking. Around 2 – 3 % of the humus present in the soil is broken down by bioconversion processes every year.

Lime fertilisers

Calcium has a huge influence on the soil structure. Soil well supplied with calcium are easy to till and offer better soil structure. This not only promotes root development, but also the activity of aerobic microorganisms.
Liming does not only influence the pH regulation of the soil, but also the calcium availability for the plants. Before cultivation, the pH-value should be raised to the correct level: at least 5.8 for sandy soil, and 6.5 for other soil. Higher optimal pH-values minimise the risk of fruit russeting and damage caused by Fusarium.
The majority of lime fertilisers contain a certain amount of magnesium. This must be taken into consideration if lime is used to raise the pH.

Mineral fertilisers

The plant's requirements are best met with simple fertilisers. With multinutrient fertilisers, it must be ensured that there is an optimum ratio of the nutrients and sulphur-containing fertilisers should be used to cover the sulphur requirement. Chloride-rich fertilisers often have a positive effect as sodium chloride clearly reduces Fusarium infestation.

Foliar fertilisers

Fertilisation with foliar fertilisers (urea, Epsom salt, potassium nitrate, micronutrient fertiliser) is always recommended if an acute deficiency in a single nutrient is identified.

Soil properties

Biological composition of the soil
It is essential that the biological activity of the soil is stimulated to guarantee good availability of the nutrients. The soil organisms can be defined as either animal (soil fauna) or plant (soil flora), and include nematodes, spring tails, earthworms and fungi, algae, bacteria. The mineralisation of nutrients and a multitude of chemical and physical processes in the soil are dependent on the activity of the soil organisms. Without these processes, the nutrients are only available to the plants to a limited extent.

Physical composition of the soil
In addition to the chemical and biological soil characteristics, the physical soil characteristics are vitally important for plant growth. Texture, structure and pore volume as well as the water content determine the physical properties of the soil and have a strong influence on the ability of the roots to penetrate the soil. A large root volume gives the plant the opportunity to take up and store nutrients and water from the deepest areas.

Life is not possible without water and air.

Correctly interpret the pH-value
The pH-value is a measure of the acidity of the soil, or the hydrogen ion activity (H^+). The pH-value is directly influenced by the amount of other cations present in the soil. These are Ca, Mg, K, and Na. The cation exchange capacity is determined and evaluated using soil analysis.
The type of pH-value determination must be taken into consideration during the interpretation. Comparisons of methods using the pH of H_2O and the pH of KCl, the KCl method always gave a more acidic value. The difference can be between 0.3 and 1.1 units.

Fertilisation consultation
As the correct fertilisation is dependent on a wide range of factors, no fertilisation advice is offered in this issue. The most important bases for a fertilisation consultation are knowledge of the soil properties, variety characteristics and the climatic conditions. Please contact the consultant of your choice to have a precise fertilisation plan created for you based on soil analyses.

Notes

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