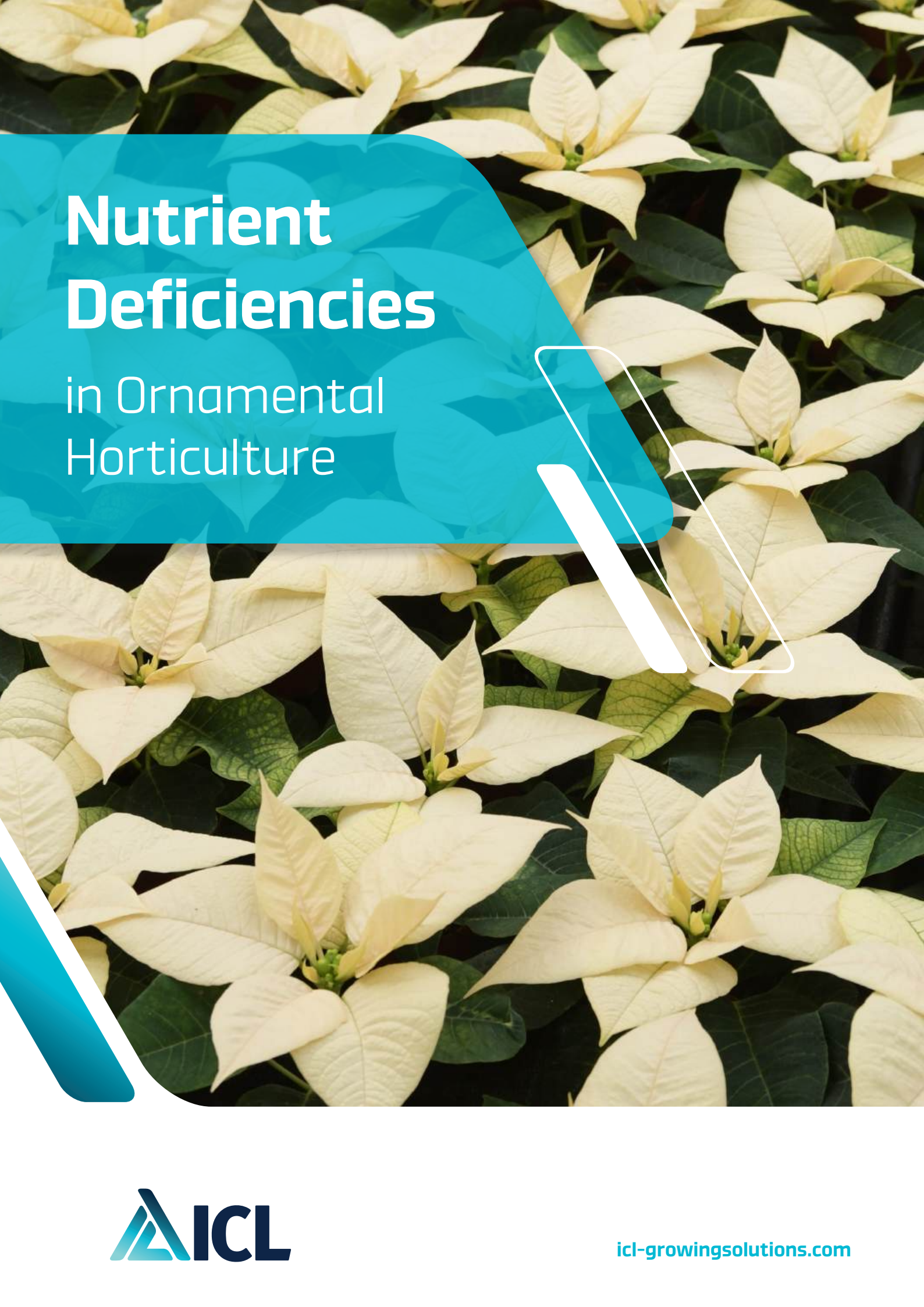




Nutrient Deficiencies

in Ornamental
Horticulture



Deficiencies

Nitrogen	6
Phosphorus	8
Potassium	10

Calcium	12
Magnesium	14
Sulfur	16

Iron	18
Zinc	20
Manganese	22
Copper	24
Boron	26
Molybdenum	28



Introduction to **Nutrient Deficiencies** in Ornamental Horticulture

Healthy plant growth depends on a balanced supply of essential nutrients. When even one element is missing or unavailable, plants cannot perform key physiological processes. Growth slows, quality declines, and characteristic visual symptoms begin to appear. Because each nutrient plays a specific role, the element in shortest supply becomes the limiting factor for development.

Recognising nutrient deficiencies starts with understanding the basic symptoms. Plants often signal imbalance through changes in leaf colour, shape, or structure.

Common signs include:

\\ Chlorosis

Leaves turn pale or yellow while the veins may remain green.

\\ Marginal browning

The edges of leaves dry out and turn brown.

\\ Leaf necrosis

Patches of tissue die and become brown, brittle, or papery.

\\ Discoloration

Leaves may redden, bronze, or develop unusual hues.

\\ Leaf curl

Leaves roll upward or downward along the margins.

\\ Leaf deformation

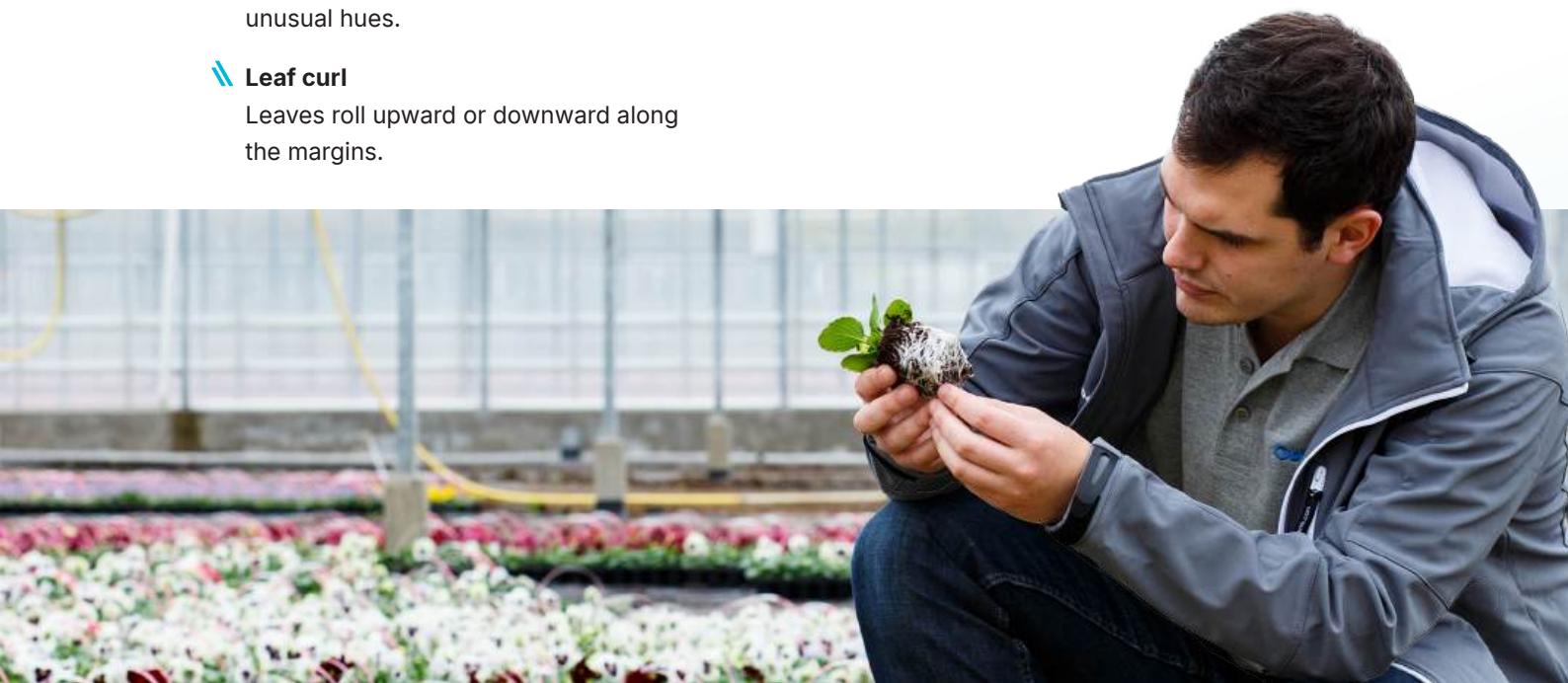
New leaves emerge distorted, rippled, or irregular.

\\ Leaf drop

Older or severely affected leaves fall prematurely.

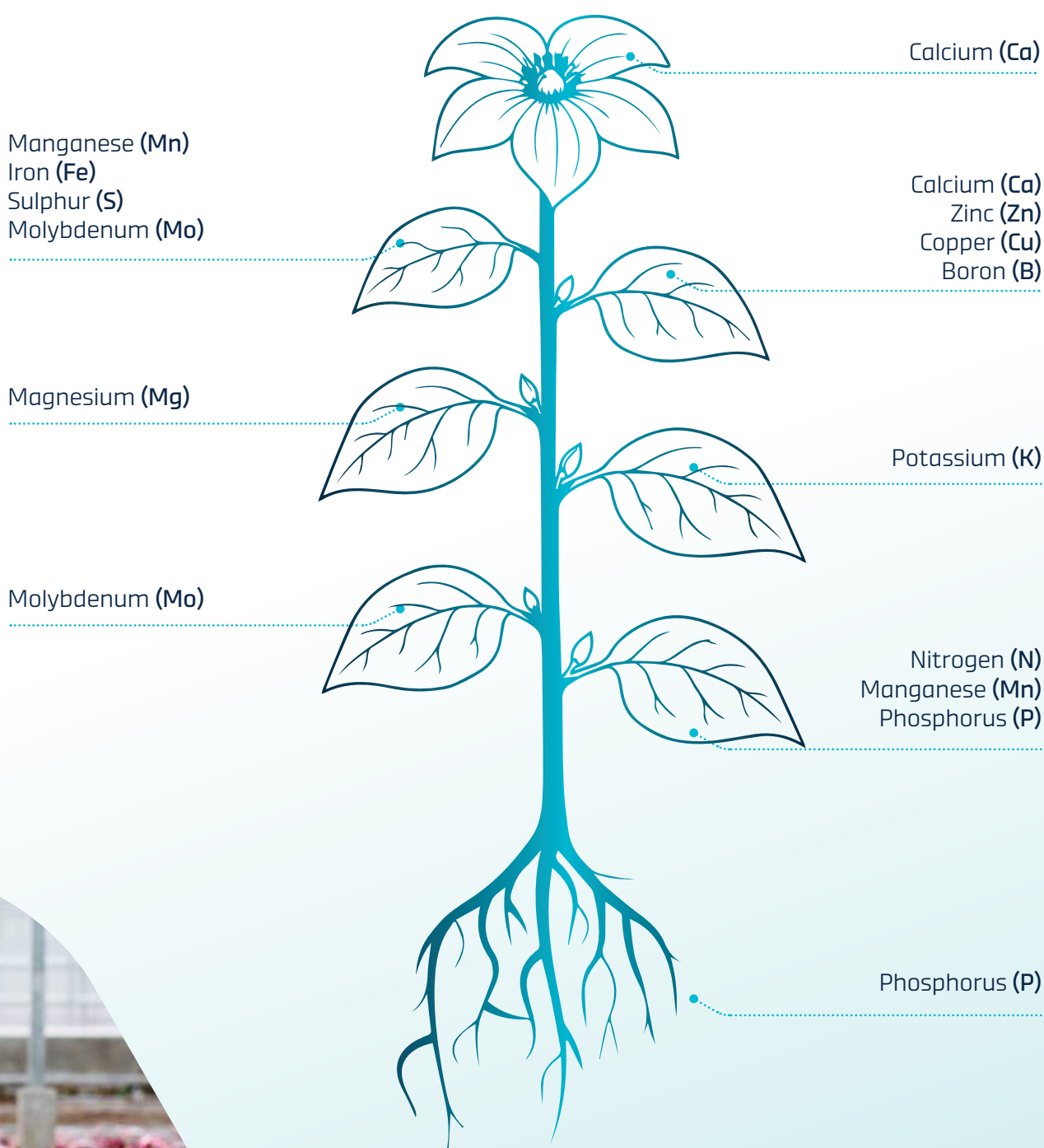
\\ Stunted growth

Shoots, leaves, or the entire plant remain smaller than normal due to limited cell division and expansion.



Where these symptoms appear depends on the mobility of the nutrient: some deficiencies show first on young leaves, others on older foliage, roots, shoots, or even flowers.

Accurate diagnosis combines visual assessment with soil and tissue analysis to confirm which nutrient is lacking or unavailable. Once identified, deficiencies can be corrected through targeted fertilisation, pH adjustment, or improvements to growing conditions, helping plants regain access to the elements they need for strong, uniform growth.





Nitrogen

deficiency

Nitrogen is one of the key macronutrients for plant growth, being the backbone of amino acids, proteins, and chlorophyll.

Nitrogen (N) deficiency is one of the most common nutritional problems in horticulture. Plants require a steady supply of nitrogen for growth and development, as it forms the basis of amino acids, proteins, chlorophyll, and nucleic acids, i.e. molecules essential for virtually every physiological process. Because nitrogen is highly mobile within the plant, symptoms typically appear first on the oldest leaves.

Symptoms



Leaf yellowing (chlorosis)

The earliest and most characteristic sign. Older, basal leaves turn yellow first, usually starting at the tips and margins and progressing in a V shaped pattern toward the midrib. Leaf veins often remain green. Severely affected older leaves may eventually drop.



Stunted growth

Plants show reduced overall vigor, with shorter stems and noticeably smaller leaves, giving a compact, restricted appearance.

Stem weakening

In more advanced cases, stems become thin, weak, and more prone to damage or breakage.

General plant yellowing

As the deficiency progresses, the entire plant may take on a pale green or yellowish tone.

Red or purple discoloration

Some species may develop reddish or purplish hues on older leaves. This is common in sensitive plants such as begonia, marigold, and violet celosia.



Reduced flowering

Nitrogen deficiency can limit flower initiation and development, resulting in fewer or smaller blooms.



Root system changes

Deficient plants often develop thinner, elongated roots as they search for available nitrogen.

Effects

Reduced photosynthesis

Nitrogen is a core component of chlorophyll, the pigment responsible for capturing light energy. When nitrogen is lacking, chlorophyll production drops, limiting the plant's ability to photosynthesize and generate energy.

Lower yields and quality

Nitrogen deficiency can significantly reduce the commercial value of ornamental crops. Plants may show smaller overall size, weaker flowering, and aesthetic flaws that make them less marketable.

Higher susceptibility to stress

Plants weakened by nitrogen shortage are more vulnerable to pests and diseases because they lack the resources to maintain strong natural defenses.



Philadelphus plant (left) with chlorotic leaves and overall stunted growth.

Management

Fertilization

Nitrogen deficiencies can be corrected with Osmoform NXT, Osmocote Topdress FT or with Osmocote. For future crops review the Osmocote longevity and dosage rate to avoid the need to topdress. To restore adequate nitrogen levels, supply nitrogen through a balanced fertilization strategy. The choice of product and application method should reflect both the plant's needs at its specific phenological stage and the characteristics of the irrigation water. Each nitrogen form, nitrate, ammonium, and urea - behaves differently in the substrate, so selecting the most effective form for the crop and conditions is essential.

Targeted nitrogen applications

When a deficiency is already established and a rapid correction is needed, especially during critical growth phases, a fertilizer with a higher nitrogen content can be applied. In severe cases, foliar feeding with dedicated nitrogen formulations can provide a quick, temporary boost while root nutrition is restored.

Field-grown ornamental nursery

For open field ornamental production, prepare the soil in advance by incorporating organic matter to improve nitrogen retention and stimulate microbial activity. A controlled release fertilizer tailored to the crop can ensure a steady nutrient supply over time. Mulching helps conserve soil moisture and reduces nutrient leaching, keeping available nitrogen more accessible to the root zone.

pH management

Keep the substrate or soil pH within the optimal range for nutrient uptake. pH strongly influences the availability of nitrogen and other essential elements, so maintaining the correct pH is a key part of preventing recurring deficiencies.



Yellow spots with reduced chlorophyll content on a leaf of Guzmania 'Ostara'.



Chlorosis in older leaves of Doronicum.



Phosphorus

deficiency

Phosphorus (P) is essential for root development, energy transfer, and early growth

When it becomes limited, plants struggle to establish a strong root system and produce compact, healthy growth. Phosphorus deficiency develops slowly and often goes unnoticed until symptoms become more pronounced, especially in cold (below 13°C , wet, or high pH (above 6.5) substrates where P availability is naturally reduced.

Symptoms



Stunted growth

Plants remain small and compact, with reduced vigor and poor establishment.



Reduced root development

Phosphorus has a direct influence on the development of the root system. In case of P deficiency, plant roots are poorly developed and shallow.



Leaf coloring

Plants that lack phosphorus often have dark green leaves with a dark green color, with purple brown margins or veins due to anthocyanin buildup.

Leaf necrosis

In severe cases, necrotic spots or borders may develop. Phosphorus deficiency can lead to the death of older leaves.



Delayed flowering and reduced bud formation

Plants may produce fewer flowers or bloom later than expected.

PHOSPHORUS deficiency

Effects

Lower yields

The most significant impact of phosphorus deficiency is reduced yields. Plants need phosphorus to carry energy inside, for photosynthesis and various metabolic processes, all essential aspects for the production of healthy flowers (and also fruits).

Impaired resilience

Weak and stressed plants are more susceptible to diseases and pest infestations. Plants that are deficient in phosphorus are often less able to cope with such stresses. In the case of a reduced root system, there will be a greater susceptibility to water stress.

Management

Phosphate fertilization

You can correct the phosphorus deficiency by providing it with fertilizers that contain it in an adequate way. Even though it is a primary macro-element, the requirement is lower than nitrogen or potassium. Important in the rooting phase, it can be added with specific fertilizers. The choice of fertilizer depends on the specific needs of the plants you are growing, there are plants whose supply should be severely limited (for example the Blue hydrangea or Australian and South African Proteaceae species. Plants that can be sensitive to too much phosphorus should be fertilized using Osmocote Pro Low P).

Field-grown nurseries

Phosphorus is less mobile in soil than other nutrients, so it is essential to apply it before or during planting to ensure that it is available when the plants actually need it. A controlled release fertilizer can overcome these problems.

pH management

Check and adjust substrate pH. High pH reduces phosphorus solubility, while very low pH can also limit availability. Maintaining the optimal pH range improves P uptake and overall nutrient balance.

Temperature management

In protected environments, maintain suitable temperatures. Cold substrates significantly reduce root activity and phosphorus uptake. Phosphorus deficiency is a common issue in ornamental horticulture but can be effectively managed through substrate analysis, appropriate fertilizer selection, and proper pH and temperature control. While preventing deficiency is important, excess phosphorus should also be avoided, as it can leach from the substrate and contribute to environmental problems such as water pollution.



Petunia plant (right) with purplish leaves caused by phosphorus deficiency.



Verbena plants (right) showing symptoms of phosphorus deficiency like stunted growth and leaf necrosis.



Phosphorus-deficient Hypericum (right) shows stunted growth and dark purple leaf colour.



Potassium

deficiency

Potassium (K) is a primary macronutrient essential for healthy plant growth regulating photosynthesis, enzyme activation, water balance, and stress tolerance.

When levels are insufficient, ornamentals lose vigor, become more sensitive to abiotic stress, and show visible decline in leaf and shoot quality. Potassium deficiency typically appears first on older leaves, as K is mobile within the plant. Unnoticed until symptoms become more pronounced, especially in cold (below 13°C , wet, or high pH (above 6.5) substrates where K availability is naturally reduced.

Symptoms



Stunted growth

Plants remain smaller, with shorter stems and reduced overall vigor.

Weak stems

Potassium deficiency weakens cell structure, making stems more prone to bending, flopping, or breaking.



Leaf marginal browning and necrosis

One of the most typical signs. Leaf edges turn brown, then dry and necrotize.

Leaf interveinal yellowing

Chlorosis often begins at the leaf margins and progresses inward, creating a mottled appearance.

Leaf curling

Leaves may curl upward along the edges. In severe cases, premature leaf drop can occur.

Effects

Lower yields and reduced ornamental quality

Flowers may be smaller, fewer, and less uniform, reducing marketability and economic return.

Reduced resilience

Potassium plays a central role in osmoregulation and overall plant strength, so deficient plants are far less resilient under stress. They become more vulnerable to drought, cold, and salinity, as their ability to regulate water balance is compromised. At the same time, weakened tissues and reduced metabolic activity lower the plant's natural defenses, making potassium-deficient crops more susceptible to diseases and pest attacks. Together, these factors significantly reduce the plant's capacity to withstand environmental and biotic pressures.



Potassium-deficient leaves of Caryopteris with chlorosis and necrotic margins.

Management

Fertilization

The majority of plants receiving the recommended dosage rate of Osmocote will have sufficient potassium. For plants that require additional potassium, High K variants of Osmocote are available. To correct an existing deficiency, additional potassium can be supplied through Peters Professional water-soluble fertilisers.

pH management

Nutrient availability, including potassium, is influenced by substrate pH. For optimal K uptake, maintain pH between 6.0 and 6.5. Adjust if necessary.

Irrigation management

Proper irrigation scheduling helps prevent nutrient leaching - one of the common causes of potassium deficiency in container crops.

Foliar applications

In severe cases, foliar sprays containing potassium can provide a quick, temporary boost while root-zone levels are corrected.

Final Considerations

Preventing potassium deficiency is essential, but excess potassium should also be avoided, as it can cause nutrient antagonisms, especially with magnesium and calcium. Regular monitoring of substrate nutrient levels, combined with close observation of plant health, ensures effective management and supports strong, high-quality ornamental production.



The leaves of potassium-deficient Kentia with marginal necrosis.



Primula showing potassium deficiency symptoms as marginal necrosis on leaves.



Calcium

deficiency

Calcium is an essential secondary macronutrient that plays a key role in building strong cell walls and supporting numerous metabolic processes.

Calcium is not very mobile within the plant and therefore the deficiency symptoms appear first in young, actively growing tissues.

When plants do not receive enough calcium, their structural integrity and growth processes are compromised. Early recognition and proper management are crucial to prevent long-term damage and maintain high ornamental quality.

Symptoms



Marginal necrosis on young leaves

One of the earliest and most typical signs is necrosis at the tips and edges of young leaves, often preceded by marginal chlorosis.

Leaf distortion

Affected leaves may curl, twist, or become misshapen, and often remain smaller than normal.

Irregular leaf development

New foliage may emerge deformed or with uneven growth patterns.



Weak floral stems

Flowering shoots may bend or collapse due to weakened cell structure.

Poor flower formation

Buds may be small, weak, or malformed

Bract necrosis in sensitive species

In highly sensitive plants such as poinsettia, calcium deficiency often causes marginal necrosis on the bracts.

Blossom end rot and fruit deformation

In susceptible species (e.g. Solanaceae), fruits may develop irregular shapes or uneven growth.



Roots

May appear thickened, brittle, and lacking root hairs, resulting in reduced nutrient and water uptake.

Effects

Stunted growth

Calcium is vital for cell division and elongation. Deficiency slows growth, reduces plant size, and limits root development, further restricting nutrient uptake.

Increased susceptibility to stress

Weakened cell walls make plants more vulnerable to diseases, pathogens, and environmental stress.

Reduced ornamental value

Leaf necrosis, poor flowering, and distorted growth significantly reduce the aesthetic and commercial value of ornamental plants.



Calcium-deficient Rosa with leaf necrosis.

Management

\\ Irrigation water analysis

Testing irrigation water helps determine whether calcium supplementation is needed. Soft or reverse-osmosis water may require calcium enrichment. Hard water may contain calcium, but its availability can be limited by pH or bicarbonates.

\\ Substrate calcium content

Calcium is also supplied in substrate gypsum applications. Growing media often contains calcium from lime (calcium carbonate or calcium-magnesium carbonate) used to adjust pH. Knowing the substrate's buffering capacity and calcium release is essential.

\\ Fertilization strategies

Use calcium-containing fertilizers such as calcium nitrate, Peters® Excel CalMag. For rapid correction, foliar applications (calcium chloride or calcium chelates) can provide immediate support.

\\ Irrigation management

Irregular watering or fluctuating substrate moisture can worsen calcium deficiency. Maintaining consistent, even moisture improves calcium uptake.

\\ Nutrient balance

Excess cations such as Mg^{+} , K^{+} , NH_4^{+} , and Na^{+} compete with calcium and reduce its absorption. Balanced fertilization is essential.

\\ Environmental factors

High humidity reduces transpiration, limiting calcium transport to growing tissues. Excessive salinity or very low pH can restrict calcium availability. Monitoring pH is especially important, as it directly affects nutrient uptake.



Bracts of Poinsettia with necrotic edges caused by calcium deficiency.



Calcium-deficient Primula showing with yellowing leaf edges and marginal necrosis.

Accurate diagnosis is essential before applying corrective measures. Maintaining balanced nutrition, stable irrigation practices, and appropriate environmental conditions significantly reduces the risk of calcium deficiency in ornamental crops.



Magnesium

deficiency

Magnesium (Mg) is the central atom of the chlorophyll molecule and plays a key role in photosynthesis, enzyme activation, and carbohydrate transport.

Because magnesium is mobile within the plant, deficiency symptoms appear first on older leaves, as the plant reallocates magnesium to support new growth.

Magnesium availability can be reduced by very low substrate pH, nutrient antagonisms (especially excess potassium or calcium), or leaching in light, low-CEC substrates. Magnesium deficiency is a common nutritional disorder in ornamental crops, and if left untreated, it can compromise plant health and final production quality.

Symptoms

Magnesium deficiency typically begins on the older, lower leaves, where the plant withdraws magnesium to support new growth. Characteristic symptoms include:



Stunted growth

Reduced chlorophyll limits photosynthesis, slowing overall plant development.



Interveinal chlorosis on older leaves

Yellowing between the veins while the veins remain green. This occurs because magnesium is a key component of chlorophyll.

Leaf curl

In more advanced cases, older leaves may curl upward or downward as tissue weakens.

Premature leaf drop

Severely affected older leaves may fall early.



Reduced fruit or flower development

In fruiting or flowering ornamentals, magnesium deficiency can reduce quality and uniformity.

The contrast between green veins and yellow interveinal areas is a key diagnostic feature.

Effects

Reduced photosynthesis

As the central atom of chlorophyll, magnesium deficiency directly limits the plant's ability to capture light energy.

Poor nutrient absorption

Magnesium deficiency can impair the uptake of other nutrients, leading to secondary deficiencies.

Lower yields and reduced quality

In ornamental and horticultural production, magnesium deficiency leads to weaker growth, poor coloration, and reduced market value.

These effects are often linked to low pH, nutrient antagonisms, or irregular fertilisation, rather than a lack of magnesium in the fertiliser program.



Chlorosis in magnesium-deficient *Chamaecyparis lawsoniana* 'Ellwoodii'.

Management

Visual assessment, substrate analysis, and leaf analysis: begin with visual diagnosis and confirm with substrate or foliar analysis when needed.

Fertilization

Apply magnesium sulphate (Epsom salt) or controlled-release fertilizers containing magnesium. Calcium–magnesium carbonate can also be used preventively as a pH-correcting component in substrates.

Foliar applications

For rapid correction, apply magnesium-containing foliar fertilizers at recommended rates.

Organic matter

In open fields, incorporating compost or well-decomposed manure improves long-term magnesium availability.

pH management

Very acidic substrates reduce magnesium availability. Adjust pH toward the optimal range for the crop.

Irrigation management

Avoid excessive irrigation that leads to nutrient leaching. Well-planned irrigation helps maintain magnesium availability.

Crop rotation

In field production of cut flowers, rotating crops helps prevent nutrient depletion in soils used repeatedly for similar species.

Regular monitoring

Track plant response and adjust fertilization and cultural practices as needed.

Final Considerations

Magnesium deficiency is a frequent issue in ornamental horticulture, especially in low-buffer substrates or when fertilisation is unbalanced. Because magnesium is mobile, symptoms appear first on older leaves, making early diagnosis straightforward. With proper nutrient balance, pH management, and regular monitoring, growers can prevent magnesium deficiency and maintain strong, uniform plant growth.



Chlorotic spots caused by magnesium deficiency on the leaves of *Guzmania*.



Light green spots with reduced chlorophyll content caused by magnesium deficiency are visible in *Ficus* leaves.



Sulfur deficiency

Sulfur is an important secondary macroelement involved in protein synthesis, enzyme activity, and chlorophyll formation.

Because sulfur is only moderately mobile, deficiency symptoms appear first on the youngest leaves. When sulfur is limited, key physiological processes slow down: plants develop smaller, chlorotic leaves, growth is reduced, and overall quality declines. Maintaining adequate sulfur levels is therefore crucial for balanced, healthy plant development.

Symptoms



Chlorosis and deformation of young leaves

Early symptoms include yellowing, distortion, wrinkling, or thickening of newly formed leaves.

Necrotic areas at leaf tips and margins

Brown or dead tissue may develop at the apex or along the edges, often progressing inward.

Brittle or corky texture

In some species, leaves become unusually thick, brittle, or fragile.



Stunted and irregular shoot growth

Reduced stem elongation, short internodes, and compromised apical meristems. Severe cases may produce witches' broom-like growth.

Flower deformation

Flowers may be small, malformed, or collapse prematurely due to impaired tissue development.



Reduced root elongation

Roots may appear shorter, thicker, and less branched.

Death of root tips

Meristematic root tissues are particularly sensitive to sulfur deficiency.

Effects

Lower ornamental quality

Insufficient sulfur significantly reduces visual quality, color intensity, and uniformity.

Reduced resilience

Weakened plants are more vulnerable to fungal diseases, pests, and abiotic stress, further compromising yield and marketability.

Management

Fertilization

You can correct sulfur deficiency by applying sulfur-containing fertilizers such as Osmocote Topdress FT. For future crops, review the Osmocote application rates and the rate of gypsum added to the substrate.

pH management

Substrate pH strongly influences nutrient availability. Maintaining a slightly acidic pH supports optimal sulfur uptake and overall nutrient balance.

Foliar applications

In cases of severe deficiency or when a rapid response is needed, sulfur can be supplied through foliar sprays for quicker correction.

Avoiding excess

Just as deficiency is harmful, excessive sulfur can cause toxicity or disrupt the balance of other nutrients. Regular substrate analysis is essential to maintain optimal levels and intervene promptly when needed.

Sulfur deficiency is a relatively common issue in ornamental horticulture, especially in low-sulfur substrates or when nutrient balance is disrupted. Fortunately, it can be effectively managed through regular substrate analysis, appropriate fertilization, and proper pH control. While preventing deficiency is important, excessive sulfur should also be avoided, as it may lead to nutrient imbalances or toxicity. Maintaining a well-balanced nutrition program and monitoring growing conditions are essential to ensure strong, healthy, and resilient plants.



Poinsettia with sulfur deficiency manifested by chlorosis on the youngest leaves.



Sulfur deficiency symptoms as yellowing youngest leaves in Poinsettia.



Pelargonium with sulfur deficiency symptoms (right) manifested as yellowing on the youngest leaves and stunted growth.



Iron

deficiency

Iron is an essential micronutrient involved in chlorophyll formation and several metabolic processes that support healthy plant growth.

Although required only in small quantities, iron plays a critical role in photosynthesis and energy production. Because iron is immobile within the plant, deficiency symptoms appear first on young leaves and new shoots.

Iron deficiency, commonly known as iron chlorosis, is a widespread issue in ornamental horticulture, especially in crops grown in alkaline substrates or irrigated with water high in bicarbonates. Importantly, the disorder is rarely caused by insufficient iron fertilization. In most cases, iron is present in the growing media but becomes unavailable due to high pH, root stress, or competition with other nutrients. Acid-loving species are particularly sensitive.

Symptoms



Interveinal chlorosis on young leaves

Pale or yellow tissue with green veins; in severe cases, leaves may become almost white

Premature leaf drop

Severely chlorotic leaves may fall early

Leaf necrosis (advanced stages)

Brown, dead patches on the youngest leaves



Stunted growth

Reduced chlorophyll limits photosynthesis and slows shoot development



Poor flower development

Reduced bud formation and weaker flowering

Because older leaves remain green, iron deficiency is easy to distinguish from nitrogen or magnesium deficiency.

Effects

Reduced photosynthesis

Iron is essential for chlorophyll synthesis. Low availability limits energy production and slows growth.

Increased susceptibility to stress

Chlorotic plants are weaker and more vulnerable to diseases, pests, drought, and temperature extremes.

Overall decline in plant quality

Chronic deficiency leads to weak growth, poor flowering, and reduced market value.

Management

\\ Analyse substrate and irrigation water

Check pH and bicarbonate levels. Iron deficiency is common in alkaline conditions.

\\ Fertilization

Micromax Premium contains iron and other essential trace elements and should be incorporated in the substrate before potting. Chelated iron such as Fe-EDDHA or Fe-DTPA provide iron in a form that plants can absorb efficiently. Chelated iron is available in Micromax WSF Fe, Micromax WS TE Mix and in Peters water soluble fertilisers.

\\ Manage pH

Lower high pH using acidifying fertilisers or elemental sulfur. Prevent pH rise by using irrigation water with low bicarbonate content. pH levels have a significant effect on nutrient availability.

\\ Improve root conditions

Avoid waterlogging, ensure good aeration, and maintain optimal temperatures to support root uptake.

\\ Add organic matter

In open fields, compost or well-decomposed manure improves soil structure and micronutrient availability.

\\ Monitor plants regularly

Early detection of chlorosis allows timely correction before growth and quality are affected.

Iron deficiency in floriculture production can be a difficult problem to avoid, especially if you operate in alkaline soils or on substrates where the pH has risen. Proper soil or substrate management and nutrient integration are essential to keep plants healthy and vigorous.

Iron deficiency is a common nutritional disorder in ornamental horticulture, particularly in alkaline substrates or when irrigation water contains high bicarbonates. Because the issue is usually poor uptake rather than lack of iron, effective management focuses on pH control, water quality, and maintaining healthy root conditions. With proper monitoring and timely correction, plants can quickly recover their colour, vigour, and ornamental value.



Young pale leaves of Calibrachoa with symptoms of iron deficiency.



Three plants of Potentilla tridentata 'Nuuk' showing iron deficiency of different severity.



Chamaecyparis lawsoniana 'Columnaris' showing iron deficiency induced chlorosis.



Zinc

deficiency

Zinc (Zn) is an essential micronutrient involved in auxin synthesis, enzyme activation, and protein formation.

Because zinc is poorly mobile within the plant, a continuous external supply is required to support uniform growth and development. When zinc availability is limited, biochemical processes slow down, leading to visible symptoms that compromise plant quality and overall performance.

Symptoms



Interveinal chlorosis on young leaves

One of the earliest and most characteristic symptoms. Leaf tissue between the veins turns pale yellow, whitish, or light green, while the veins remain distinctly green. In advanced stages, affected areas may progress to necrosis.

Leaf deformation

Young leaves may emerge distorted, with irregular margins, puckering, or a rippled surface.



Stunted growth and shortened internodes

Plants exhibit reduced shoot elongation, smaller leaves, and in some species a rosette-like appearance.



Delayed and reduced flowering

Zinc deficiency slows floral initiation and results in smaller, lower-quality blooms.



Weak root systems

Root growth is restricted, producing finer, less extensive root structures that increase susceptibility to stress and disease.

Effects

Reduced ornamental quality

Chlorosis, deformation, and poor flowering significantly diminish the commercial value of plants.

Higher susceptibility to stress and pathogens

Weak root systems and impaired metabolic activity increase vulnerability to abiotic stress and certain diseases.

Economic loss

Lower vigor and aesthetic quality directly impact marketability and production efficiency.



A leaf of a zinc-deficient Poinsettia with interveinal chlorosis.

Management

Fertilization

Correct deficiencies using zinc-containing fertilizers such as Micromax Premium, Micromax WSF TE Mix. For future crops review Osmocote or Peters rates and consider using Osmocote 5 with Optimised Trace Element Availability.

Foliar applications

In acute deficiency, foliar Zn treatments provide rapid uptake and visible improvement in new growth. These applications offer short-term correction but should be integrated into a broader nutrition plan.

pH management

Zinc availability decreases sharply in alkaline substrates. Optimal Zn uptake occurs at pH 5.6–6.5. Adjusting substrate pH is often essential for long-term correction.

Irrigation management

Over-watering or uneven moisture distribution can limit Zn uptake. Maintain consistent moisture levels and avoid excessive leaching.

Symptoms may vary by species, so regular monitoring, substrate analysis, and leaf tissue testing are essential. While correcting deficiencies is important, excessive zinc can cause toxicity, so applications must be carefully calibrated to crop needs.



A yellowish leaf of Pelargonium shows zinc deficiency symptoms.



Poinsettia with yellowing leaves suffers from zinc deficiency.



Manganese

deficiency

Manganese is an essential micronutrient involved in photosynthesis, redox reactions, and enzyme activation

Because manganese is poorly mobile within the plant, deficiency symptoms appear first on younger leaves. Insufficient Mn disrupts chloroplast function and metabolic activity, leading to chlorosis, necrosis, and a general decline in plant vigor.

Symptoms



Interveinal chlorosis on young leaves

The most characteristic symptom. Leaf tissue between the veins turns yellow while the veins remain green, creating a net-like pattern. Necrotic spots may develop within chlorotic areas as the deficiency progresses.

Leaf necrosis

Severe Mn deficiency causes the chlorotic tissue to collapse, resulting in necrotic patches, reduced leaf size, and weakened overall growth.

Leaf discoloration

Some species may show reddish or purplish hues on older leaves, particularly along the margins.



Stunted growth

Reduced shoot elongation, smaller leaves, poor root development, and lower flower production are common in prolonged deficiency.

Effects

Reduced photosynthesis

Manganese is essential for the oxygen-evolving complex in chloroplasts. Deficiency limits photosynthetic efficiency and reduces energy production.

Impaired nutrient interactions

Low manganese can disrupt the uptake and balance of other nutrients, particularly iron and calcium, intensifying overall nutritional stress.

Higher susceptibility to stress and diseases

Plants weakened by Mn deficiency are more vulnerable to pathogens and abiotic stress factors.



Reddish and purplish spots in Pieris leaves caused by manganese deficiency.

Management

Leaf tissue analysis

Because Mn deficiency can resemble iron deficiency, tissue analysis is recommended for accurate diagnosis.

Fertilization

Correct deficiencies using Manganese-containing fertilizers such as Micromax Premium, Micromax WSF TE Mix. For future crops review Osmocote or Peters rates and consider using Osmocote 5 with Optimised Trace Element Availability.

pH management

The effects of pH levels affect the availability of nutrients. Manganese availability decreases sharply in alkaline substrates. Optimal uptake occurs at lower pH levels; adjusting substrate pH is often essential for long-term correction.

Irrigation management

Excessive irrigation can leach Mn from the root zone. Maintain consistent moisture and avoid over-watering to preserve micronutrient availability.

While correcting deficiencies is important, excessive manganese can also be toxic. Regular substrate and tissue analysis, combined with close crop monitoring, ensures balanced Mn supply and supports healthy, uniform ornamental production.



Spathiphyllum with yellowing to necrotic leaf edges caused by manganese deficiency.



Kalmia leaves with interveinal chlorosis and necrotic tips caused by lack of manganese.



Copper deficiency

Copper is an essential micronutrient involved in photosynthesis, respiration, vitamin formation, and several enzyme systems that regulate plant growth.

Copper also plays a key role in lignin formation, which strengthens cell walls and supports structural rigidity. Because copper is relatively immobile within the plant, deficiency symptoms typically appear first on young leaves and new shoots.

Copper deficiency is more common in crops grown in peat-based substrates, very sandy soils, or media with high organic matter, where copper becomes strongly bound and unavailable. High pH, excessive liming, or imbalanced fertilization can further reduce copper uptake. If not corrected, copper deficiency can lead to weak growth, poor flowering, and increased susceptibility to diseases.

Symptoms



Interveneal chlorosis on young leaves

Yellowing between the veins is one of the earliest and most common signs.

Leaf necrosis

As the deficiency progresses, necrotic patches may develop at the leaf margins or between veins. Affected areas turn brown and dry.

Distorted or twisted new growth

Young leaves may curl or lose stiffness due to impaired lignification.



Stunted growth and weak shoots

Plants may show reduced stem elongation, soft or flexible shoots, and a general lack of vigor.

Rosette-like apical development

Growing points may become compact, producing small, distorted leaves and malformed flowers.



Poor flowering

Buds may be small, deformed, or fail to open properly.

Because copper is not easily redistributed within the plant, symptoms remain concentrated on young tissues.

Effects

Reduced photosynthesis

Copper is essential for enzymes involved in energy production; deficiency slows growth and reduces vigor.

Weak structural development

Poor lignification results in soft stems, weak shoots, and increased breakage.

Higher susceptibility to pathogens

Copper contributes to natural plant defense mechanisms. Deficient plants are more vulnerable to fungal and bacterial infections.

Overall decline in plant quality

Chronic deficiency leads to poor growth, weak structure, and reduced ornamental value.



Copper-deficient Lonicera with affected young shoots.

Management

Fertilization

Correct deficiencies using copper-containing fertilizers such as Micromax Premium, Micromax WSF TE Mix. For future crops review Osmocote or Peters rates and consider using Osmocote 5 with Optimised Trace Element Availability.

pH management

Copper availability decreases sharply in alkaline substrates. Lowering pH improves copper uptake. Remember that pH affects the availability of all nutrients, not only copper.

Balanced micronutrient supply

Using complete micronutrient packages ensures copper is supplied in the correct proportion and prevents imbalances.

Monitor plant response

Track improvements after treatment and adjust copper inputs carefully to avoid toxicity.

Improve root conditions

Ensure good aeration and avoid waterlogging to support nutrient uptake.

Copper deficiency is a relatively uncommon but impactful disorder in ornamental horticulture. Because copper is required in small amounts yet plays a vital role in structural strength and plant defense, even mild deficiencies can significantly affect plant quality. With proper pH management, balanced micronutrient supply, and regular monitoring, growers can prevent copper deficiency and maintain strong, resilient plants.



Severe chlorosis on the youngest chrysanthemum leaves as a result of copper deficiency in the plant.



Chamaecyparis lawsoniana 'Columnaris' show overall weak structural development due to the lack of copper.



Boron

deficiency

Boron is an essential micronutrient required for the normal development of meristematic tissues, including the growing points of shoots, leaves, and flowers.

It plays a key role in cell wall formation, carbohydrate transport, and pollen viability. Because boron is poorly mobile within the plant, deficiency symptoms appear first in young tissues. Although not common, boron deficiency can occur in high-pH or calcareous substrates, or when excessive nitrogen disrupts micronutrient balance. When boron supply is inadequate, the development of both shoot and root apices is compromised, directly affecting plant quality and marketability.

Symptoms



Leaf yellowing (chlorosis)

One of the earliest and most characteristic symptoms is the yellowing of young leaves. Chlorosis typically begins at the tips and margins and progresses inward. In severe cases, the entire leaf may turn yellow, and the discoloration can gradually extend to older leaves. This differs from nitrogen deficiency, where yellowing starts on the oldest, basal leaves.



Stunted growth

Plants remain smaller, less vigorous, and show reduced shoot development due to impaired protein and chlorophyll synthesis.

Reduced nutrient uptake

Boron deficiency can limit the plant's ability to absorb other nutrients, especially nitrogen, leading to broader nutritional imbalances.



Delayed physiological processes

Flowering may be delayed, reducing the plant's reproductive performance and overall ornamental value.

Effects

Reduced water and nutrient uptake

Impaired root development limits the plant's ability to absorb essential resources (i.e. water and nutrients).

Lower yields and poor flowering

Boron is critical for cell division and carbohydrate metabolism; deficiency reduces both bloom quantity and quality.

Economic losses

Deformed growth, weak flowering, and reduced vigor significantly decrease the commercial value of ornamental crops.



Hibiscus with deformed young leaves caused by boron deficiency.

Management

\\ Substrate or leaf analysis

Because symptoms can resemble other disorders, analytical testing is essential for accurate diagnosis.

\\ Fertilization

Boron can be supplied through fertilizers containing borax or other boron compounds.

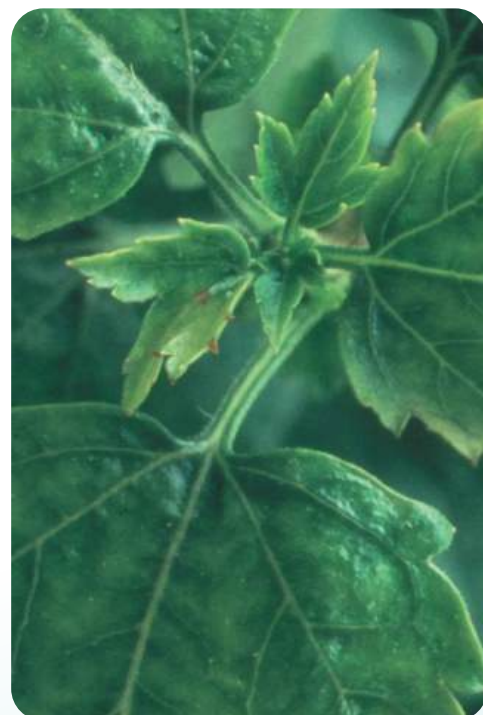
\\ Foliar applications

Caution is critical: the margin between deficiency and toxicity is narrow. Application rates must be based on analysis results and crop sensitivity.

\\ pH management

Boron availability decreases in alkaline substrates. Maintaining pH within the optimal range for the crop supports consistent uptake.

Boron deficiency varies by species and growing conditions. Regular visual monitoring, combined with substrate and tissue analysis, ensures early detection and precise correction. Because excessive boron can quickly become toxic, always follow recommended application rates and adjust fertilization programs carefully.



Boron-deficient Ribes with necrosis on leaf tips and margins.



Molybdenum

deficiency

Molybdenum (Mo) is a trace element that plants need in small quantities.

Although required only in trace amounts, molybdenum (Mo) is essential for plant development. It plays a key role in several biochemical processes, particularly in the conversion of nitrate (NO_3^-) into amino acids and proteins, and it is also involved in the synthesis of certain plant hormones. Molybdenum is partially mobile within the plant, which influences how symptoms appear and progress.

When molybdenum becomes limiting, plants show distinct and often severe symptoms, including leaf yellowing, marginal necrosis, deformation of young leaves, and necrosis in the apical parts. In sensitive species (e.g. Zinnia) flower production may be reduced, while plants prone to micronutrient imbalances (e.g. poinsettia) tend to show symptoms early and clearly.

Symptoms



Interveinal chlorosis and marginal necrosis

One of the earliest and most common symptoms is interveinal chlorosis, where tissue between the veins turns yellow while the veins remain green. This typically begins at the leaf margins, with necrosis developing as the deficiency progresses. Symptoms are often most visible on older leaves, but may spread throughout the plant.

Curling and deformation of young leaves

Young leaves and shoot tips may show upward curling, distortion, and in severe cases apical necrosis. These symptoms reflect molybdenum's role in nitrate reduction and protein formation in actively growing tissues.



Stunted growth

Plants may exhibit reduced vigor, shorter internodes, and overall smaller size due to impaired nitrogen metabolism.



Poor flower development

Flowering may be reduced, and blooms that do form can be smaller and of lower quality. This is particularly noticeable in sensitive ornamental species.

MOLYBDENUM deficiency

Effects

Lower plant quality

Stunted growth, leaf deformation, and reduced flowering significantly decrease the market value of ornamental crops.

Reduced nitrogen efficiency

Plants become less capable of using available nitrogen, which can lead to higher fertilizer costs and lower production efficiency.

Reduced nitrogen utilization

Because molybdenum is required for the enzyme nitrate reductase, deficiency leads to poor nitrate conversion, reduced amino acid and protein synthesis, and overall lower nitrogen-use efficiency.



Philadelphus with molybdenum deficiency shows deformed leaves with marginal necrosis.

Management

Test the growing media

Regular analysis of the substrate and leaf tissue helps identify molybdenum deficiency early. Leaf analysis is especially useful in poinsettia, where symptoms can resemble other micronutrient disorders.

Use the right fertilizers

Correct deficiencies using molybdenum-containing fertilizers such as Micromax Premium, Micromax WSF TE Mix. For future crops review Osmocote or Peters rates and consider using Osmocote 5 with Optimised Trace Element Availability.

Adjust substrate pH

Molybdenum availability decreases sharply at low pH, unlike many other micronutrients. Avoid allowing the substrate pH to drop too low, especially in peat-based mixes. Maintaining an appropriate pH range helps ensure consistent Mo uptake.

Molybdenum is required in very small quantities, which means both deficiency and excess can occur. While deficiency leads to chlorosis, deformation, and reduced flowering, over-application can cause molybdenum toxicity, particularly at low substrate pH. Toxicity symptoms, often seen on young leaves, may resemble deficiency, making accurate diagnosis essential. Molybdenum toxicity can interfere with the absorption and utilization of other essential nutrients, leading to imbalances in the plant.

For growers working with Mo-sensitive species, regular monitoring of nutrient levels, careful pH management, and the use of balanced, high-quality fertilizers are the most effective strategies to maintain healthy growth and avoid production losses.



Molybdenum deficiency in Caryopteris with deformations, and marginal necrosis on leaves.



Ribes showing molybdenum deficiency with yellowing margins on young leaves.



Right nutrition is a matter of **balance**

As a grower, your goal is to achieve the right nutritional balance: **every element counts**.

Even a single missing or unavailable nutrient can limit key physiological processes. The result is slowed growth, reduced overall quality, and the characteristic visual symptoms shown throughout this booklet.



How to **fix** nutrient deficiencies

- \\ Targeted fertilization to replace missing nutrients.
- \\ pH correction to improve nutrient uptake.
- \\ Better growing conditions (moisture, aeration, temperature).

How to **prevent** nutrient deficiencies

Most issues can be avoided with a well designed nutrition strategy that accounts for key growing factors.

- \\ Balanced fertilization plans that match crop needs.
- \\ Attention to growing variables such as water quality, substrate, and greenhouse climate.
- \\ Correct supply of macro, meso, and micro elements in the right ratios.



The limiting factor is always the element in shortest supply. What is not always understood is that a nutrient may be present in the fertilizer, yet unavailable to the plant due to its chemical form or the water/soil conditions. Nutrition is never only about how much you feed your plants, but how much of each nutrient the plant can actually absorb. The quality of raw materials plays a crucial role. Always source your fertilizers from a trusted supplier.

ICL advice to keep a good balance

As general rule, ICL recommends nutrition plans that combine base fertilization with **Osmocote 5**, **Osmocote Exact** or **Osmocote Pro** mixed in the growing media and Fertigation with **Peters** or **Universol**.

When needed, it is advisable to supplement with high quality, targeted trace element package such as **Micromax® Premium**.

Our technical advisors are always ready to provide the best recommendation based on your specific situation. For personalized guidance, contact your regional technical support team via your country's ICL Growing Solution's website.



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