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NUTRITIONAL DISORDERS IN CUCUMBERS AND GHERKINS UNDER GLASS

The 'Instituut voor Bodemvruchtbaarheid' (Institute for Soil Fertility) is a governmental institution. Research work includes various aspects of soil physics, soil chemistry and soil organic matter, and of plant nutrition and fertilizer application. The 'Proefstation voor de Groenten- en Fruitteelt onder Glas' (Horticultural Research and Experiment Station) was founded and is now owned by an association of growers and it is subsidized by the Dutch government. The aim of the research work is to increase production and to improve quality of vegetables grown in glasshouses. Consequently, all aspects of cultivation under glass are studied.

Cover: Sporu cucumber against a background of ungraded Levo gherkins.

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Introduction

In the Netherlands cucumber and gherkin (or pickling cucumber), both belonging to the species *Cucumis sativus* L., are cultivated in glasshouses.

Cucumbers (total area 800 ha) are mainly grown in hothouses on straw bales or on hotbeds of strawy farmyard manure or fresh town refuse. The fruits are parthenocarp. Sporu, a semi-spiny hybrid, is the most widely grown variety.

Gherkins (total area 200 ha) are grown in unheated or slightly heated glasshouses. Young plants are planted directly in the soil or sometimes in a bed of farmyard manure mixed with soil. Unlike cucumber, for fruit setting of gherkins pollination is required. Levo, a F_1-hybrid with mainly female flowers, is the variety commonly grown in the Netherlands.

This pubication intends to be a guide in diagnosing nutritional disorders (deficiencies, toxicities) in cucumber and gherkin crops by visual symptoms and plant analysis, but correct diagnosis is often only possible by including other methods, such as analysis of the substrate and studies on the response to applied nutrients (Sprague, 1964; Wallace, 1964).

Malnutrition symptoms and nutrient levels in leaves and fruits of cucumber are very similar to those of gherkin. So descriptions apply to both crops, unless otherwise stated. Studies on toxicities have been restricted to those caused by excessive levels of nutrients in the substrate.

Colour plates (from slides) and descriptions are given for nitrogen, phosphorus, potassium, magnesium, calcium, sulphur, boron, copper, manganese, molybdenum, iron and zinc deficiencies and for nitrogen, boron, manganese and zinc excess.

Mature leaves were taken for analysis from the middle of the stem, 1.25 to 1.50 m up. In commercial glasshouses these leaves were sampled two weeks after picking began. It was not always possible to follow the same sampling procedure with plants grown on peat substrates because of less profuse growth. In water culture experiments the whole top was analyzed.

Causes of mineral disorders and control methods are reported briefly. As many of the nutritional disorders to be described do not normally occur in commercial glasshouses, they have been induced in peat substrates (sphagnum) and water cultures (Smilde & Roorda van

Eysinga, 1968).
Although malnutrition symptoms may vary with variety, chemical and physical composition of the substrate, and climate, the plates and descriptions can be used for diagnosis.
To be certain that any disorder is nutritional, damage from pests and diseases, pesticides and industrial emissions, drought and excess moisture must be excluded.
In describing symptoms mention is made of the plant organ affected (old or young leaf, stem, growing point), appearance of the plant (dwarfing, branching, deformation), nature and pattern of the disorder (chlorosis, necrosis).
The concentrations of (nutrient) elements in fruits are tabulated in the last section of the booklet. Values were collected from our trials and from the literature. The figures are tabulated because fruits are the edible parts of the plant. No important difference was found between cucumber and gherkin.

Nitrogen deficiency in a gherkin plant (Levo) grown on sphagnum peat.

Cucumbers (Sporu) cultivated on sphagnum peat; left: healthy; right: nitrogen-deficient.

Leaves of cucumber plants from a commercial glasshouse; left: healthy; right: nitrogen-deficient.

Nitrogen deficiency

Symptoms Growth is stunted and the foliage fades to yellowish green. The discoloration is most pronounced in the lower leaves. Occasionally the mesophyll around the main veins remains green for some time contrasting with the yellow veins. Flowers are relatively large. In severe deficiency the whole plant turns yellow to almost white; cotyledons and lower leaves die, and younger leaves stop growing. Cucumber fruits of variety Sporu were short, thick, light or grayish green and spiny, whereas normal fruits were dark green and smooth. Hoffman (1933), Dearborn (1936), Bradley et al. (1961), Sprague (1964) and Anstett (1967) report short abnormally shaped, pale yellow fruits pointed at their blossom ends.
Nitrate is a better indication of the nitrogen status of the plant than Kjeldahl nitrogen. Nitrogen-deficient cucumber plants contained 0.1% nitrate-nitrogen in dry matter of leaves or less, healthy plants 0.1-1.6%. Nowosielski (1968) observed nitrogen deficiency in gherkin plants with a leaf concentration of less than 0.1% nitrate-nitrogen. Dearborn (1936) reported 0.03% nitrate-nitrogen in nitrogen starved gherkin plants and 0.06% in plants well supplied with this nutrient.

Incidence Deficiency can be expected in young plants when cultivated on straw bales or on hotbeds of strawy farmyard manure or fresh town refuse and if insufficient nitrogen fertilizer is applied. Older plants rarely show deficiency but occasionally symptoms occur on coarse-textured sandy soils or peat substrates.

Control Apply nitrogen at 1 kg per 100 m^2 soil (90 lb/acre; 0.3 oz/yd^2) as an inorganic fertilizer; on clay and organic soils the rate may be doubled.
Spraying with a 0.5% solution of urea is less effective. Young plants in pots can be supplied with 50-100 mg N per plant in a liquid form (e.g. 2% calcium nitrate). To avoid leaf scorching fertilizer residues should be removed with water.

Phosphorus deficiency in a gherkin plant (Levo) grown on sphagnum peat.

Phosphorus deficiency in young cucumber plants (Sporu) grown on sphagnum peat.

Phosphorus deficiency

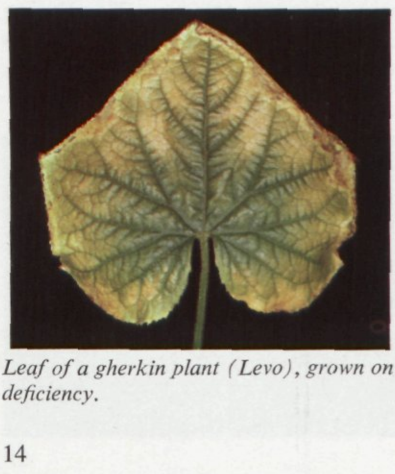
Symptoms Plants are stunted but do not show definite symptoms. Severe deficiency completely prevents growth; the younger leaves are small, stiff and dark green. Large water-soaked spots including both veins and interveinal areas appear in the cotyledons and older leaves, and spread to the younger leaves. Affected leaves fade, the spots turning brown and desiccating. The whole leaf shrivels, except for the petiole, which remains turgid for some time. Successive stages last only a few days.

Leaf phosphorus of deficient plants was 0.3% P_2O_5 in dry matter or less. Leaves of healthy plants contained normally 0.8-1.7, and sometimes up to 2.3% P_2O_5. Vogel & Weber (1932), Bradley & Fleming (1960) and Ward (1967) report about the same values. Drews (1966) found higher values in leaves of shoots. According to Anstett (1967) deficiency is to be expected with values below 0.9%. Bradley et al. (1961) report 0.3% P_2O_5 in leaves of low-yielding gherkin crops grown in the open, and 0.7-1% P_2O_5 in high-yielding crops.

Incidence Symptoms occur only in plants raised in sphagnum peat. Growth may be reduced in new glasshouses on poor soils or in glasshouses leveled with infertile subsoil, but only if neither phosphate nor farmyard manure has been applied.

Control Apply, in two portions, 5 kg P_2O_5 per 100 m^2 soil (450 lb/acre; 1.5 oz/yd^2) as triple superphosphate or polyphosphate, preferably in ample water. For young plants in pots use a 2% solution of these fertilizers, supplying 100-200 mg P_2O_5 per plant. Unless wetting of the plants can be avoided, they should afterward be watered.

Potassium deficiency in a gherkin plant (Levo) grown on sphagnum peat.



Leaf of a gherkin plant (Levo), grown on sphagnum peat, showing potassium deficiency.

Potassium deficiency

Symptoms Growth is stunted, internodes remain short and leaves small. Leaves are bronzed and discoloured yellowish green at the margins; the main veins are sunken. At a later stage interveinal chlorosis becomes more pronounced and extends towards the centre of the leaf; it is followed by necrosis. Leaf margins desiccate but the veins remain green for some time. Symptoms spread from the base towards the top of the plant, the oldest leaves being worst affected. Similar descriptions are given by Hoffman (1933), Sprague (1964) and Anstett (1967). They all also mention irregular shaped fruits (underdeveloped stem ends).

Leaves of plants with symptoms had 0.6% K_2O in dry matter; leaves of low-yielding plants without symptoms contained up to 2.5% K_2O; healthy leaves had 3-6.5% K_2O. The concentrations reported by Vogel & Weber (1932), Drews (1966), Anstett (1967) and Ward (1967) are similar, those by Bradley & Fleming (1960) and Bradley et al. (1961) somewhat lower.

Incidence Potassium deficiency is rare in commercial glasshouses in the Netherlands. It might occur on potassium-fixing soils, light sandy soils or on peat substrates if neither potash nor farmyard manure is applied.

Control Apply, in two portions, 10 kg K_2O per 100 m^2 soil (900 lb/acre, 3 oz/yd^2) as a potassium fertilizer; on light sandy soils the amount should be halved. The crop may also be sprayed with a 2% solution of potassium sulphate but soil dressing is more effective.

Leaf of a magnesium-deficient cucumber plant (Sporu) grown in water culture.

More severe magnesium deficiency (water culture).

Magnesium deficiency

Symptoms Older leaves show interveinal chlorosis proceeding from the leaf edges inward. In moderate deficiency stems and leaves grow normally. With more acute deficiency chlorosis spreads further, also including the smaller veins, and becomes more intense; only the main veins remain green. Sometimes chlorosis appears as large interveinal sunken blotches. Eventually, necrosis occurs and leaves shrivel. The symptoms spread from the older to the younger leaves and finally the entire plant turns yellow. A similar description is given by Carolus (1934) and Anstett (1967).

A type of chlorosis resembling magnesium deficiency sometimes appears in cucumber grafted on *Cucurbita ficifolia* L., especially after steam sterilization of the soil and with heavily bearing crops (Van den Ende, 1958).

In deficient plants leaf magnesium was found to be 0.37% MgO in dry matter, as against 1-2.2% in healthy plants. Vogel & Weber (1932), Drews (1966), Ward (1967) and Anstett (1967) report similar values. Carolus (1934) found 0.77 and 1.28% MgO in young and old leaves, respectively, of healthy gherkin crops and 0.36 and 0.21% MgO in leaves of deficient crops.

Incidence Magnesium deficiency may be observed on various soils if organic manuring has been neglected. Factors promoting the disorder are low pH and, probably, heavy potash or inadequate nitrogen dressings. It occurs most severely near the walls of glasshouses. In gherkins grown in the open, magnesium deficiency is particularly observed in cool rainy summers (Koomen et al., 1962).

Control Apply kieserite, dolomitic limestone or ample farmyard manure to prevent it. In acute deficiency apply, in two portions, 3-4 kg MgO per 100 m^2 soil (270-360 lb/acre, 0.9-1.2 oz/yd^2) as Epsom salt. On coarse-textured sandy soils the amounts should be smaller to avoid scorching. High or low volume spraying with a 2% or 10% solution of Epsom salt is more effective than soil application. With grafting chlorosis special attention should be paid to proper application of manure and water.

Calcium deficiency in the top of a cucumber plant (Sporu) grown in water culture.

More severe calcium deficiency (water culture).

Calcium deficiency

Symptoms The youngest leaves show transparent white dots near the edges and between the veins. An interveinal chlorosis gradually increasing in severity appears in most leaves; the main veins stay green. Growth is stunted and internodes are short, especially near the apex. The youngest leaves remain very small, their edges are deeply incised and curled upwards. Later they shrivel from the edges inwards. Older leaves curve downwards. In severe deficiency petioles are brittle and leaves shed easily. Buds abort and finally the plant dies back from the apex. The dead tissues are grayish brown. According to Hårdh (1957) flowers are smaller than normal and pale yellow; fruits remain small, and are furrowed and tasteless.
It is well known that Cucurbitaceae absorb much calcium (Wilkins, 1917). The authors of the present study found 3.3% CaO in leaf dry matter of plants with symptoms, 6% CaO or less in low-yielding crops without symptoms and 8-16% CaO in normal crops. Vogel & Weber (1932) and Ward (1967) report somewhat lower concentrations which may be attributed to the age of the leaf sampled (Ward, 1967).

Incidence Calcium deficiency may occur on soils whose calcium reserves have been depleted by leaching and also on sphagnum peat, used for raising young plants, unless lime is added.

Control Lime sphagnum peat substrates with 4 kg calcium carbonate per m^3. In acute deficiency spray with a 1% solution of calcium nitrate (0.7% if anhydrous calcium nitrate is used).

Sulphur deficiency in a cucumber plant (Sporu) grown in water culture.

Sulphur deficiency

Symptoms Plant growth is restricted. Leaves remain small, particularly the younger ones, bend downwards and are pale green to yellow. Unlike nitrogen deficiency, yellowing is least pronounced in older leaves. Margins of younger leaves are markedly serrate.
The authors found 0.06% S in leaf dry matter of sulphur-deficient plants and 0.6-0.7% in healthy plants.

Incidence To our knowledge sulphur deficiency has not been reported in commercial glasshouses. It might occur far from industrial centres if only sulphur-free fertilizers are used (Sprague, 1964).

Control Apply sulphur-containing fertilizers.

Dead bud of boron-deficient cucumber plant (Sporu) grown on sphagnum peat.

Boron deficiency in leaves of a cucumber plant (Sporu) grown in water culture.

Boron deficiency

Symptoms The apex, comprising the growing point and the youngest unexpanded leaves, curls up and dies, the dead tissues looking grayish. Axillary shoots also wither soon. Somewhat older leaves are cupped upwards and stiff, and in severe deficiency, mottled between the veins. Shoots thus stop growing altogether, giving the plant a stunted appearance. Zavališna (1955) mentions abnormal cambium activity and reduction in the number of stomata on the lower sides of the leaves. According to Quillon (1968) an adequate boron supply promotes the percentage of female flowers.
Leaves of boron-deficient gherkin and cucumber plants contained 11 and 20 ppm B, respectively, in dry matter. Healthy cucumber plants contained 40-120 ppm B. Bergmann et al. (1965) report 50 ppm B in leaves of healthy plants. Comparison is somewhat difficult, however, as these authors analyzed edges and the rest of the leaf separately. Everett (1964) found 26 ppm B in leaves of gherkin plants not supplied with trace elements, and 46-65 ppm in plants which received these nutrients.

Incidence Boron starvation in cucumber and gherkin crops is unknown in Dutch commercial glasshouses. It might occur on sandy soils after liming unless farmyard manure is applied. Symptoms may also be induced by excessive liming and insufficient watering of plants grown on sphagnum peat. According to Zavališna (1955) deficiency is more likely in spring than in autumn, probably because of a difference in light intensity.

Control Spray a 0.25% solution of borax (Quillon, 1968) and distribute evenly 200 g borax per 100 m^2 soil (18 lb/acre; 0.06 oz/yd^2). Sphagnum peat should receive 10 g borax per m^3 for cucumbers (Roorda van Eysinga, 1965) and 5 g for gherkins (Sanna, 1967).

Copper deficiency in a cucumber plant (Sporu) grown in water culture.

Copper deficiency

Symptoms Plant growth is restricted. Internodes are short, giving the plant a bushy appearance. Especially the younger leaves remain small. Interveinal chlorotic blotches may appear in older leaves, but there is not the fine chlorotic pattern typical of iron and manganese deficiency. Later the leaves turn dull green to bronze, necrosis develops and the entire leaf withers. Chlorosis proceeds from the older to the younger leaves.
Leaves of copper-deficient plants contained 2 ppm Cu in dry matter and of healthy plants 7-10 ppm.

Incidence Copper deficiency is unknown in commercial glasshouses in the Netherlands. It might occur on sphagnum peat substrates if no copper fertilizer has been applied.

Control Add 10 g copper sulphate or 150 g copper slag (1.5% Cu) per m^3 to peat substrates as a precaution. Copper sulphate may be sprayed at concentrations up to 0.1%.

Leaf of a manganese-deficient gherkin plant from a commercial glasshouse.

Manganese deficiency in a cucumber (Sporu) grown in water culture.

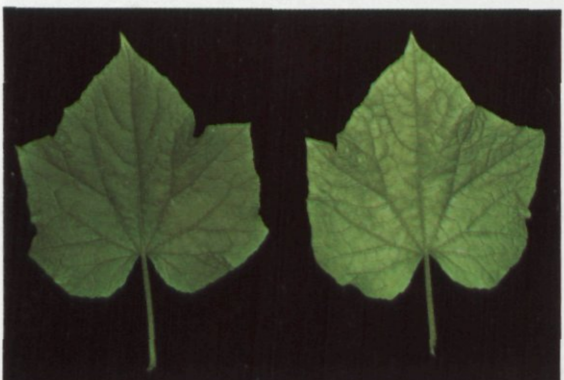
Manganese deficiency

Symptoms Yellowish interveinal mottling develops either in terminal or young leaves. At first even the smallest veins remain green, producing a fine reticular green pattern on a yellow background. Later, all the mesophyll except the main veins, turns yellow to yellowish white, and sunken necrotic spots develop between the veins. Older leaves turn palest and die first. Shoots are severely stunted and new leaves remain small. These symptoms are similar to those described by Sprague (1964).
Leaves of manganese-deficient plants contained 12 ppm Mn in dry matter, whereas healthy plants had 100-300 ppm. Finck (1954) mentions 10 and 18 ppm Mn for chlorotic and green gherkin leaves, respectively. Everett (1964) mentions 15 ppm Mn for gherkin leaves from plants without and 110-216 ppm Mn for plants with trace elements applied.

Incidence Deficiency occurs on some calcareous loam and clay soils and on excessively limed sand and peat soils.

Control High or low volume spraying with a 0.15% or 1% solution of manganese sulphate, respectively.
Application of 5 kg manganese sulphate per 100 m^2 soil (450 lb/acre; 1.5 oz./yd^2), together with sulphate of ammonia or peat moss, is also possible, though less effective in curing manganese deficiency.

Molybdenum deficiency in a cucumber plant (Sporu) grown on sphagnum peat. Note the pale lower leaves.



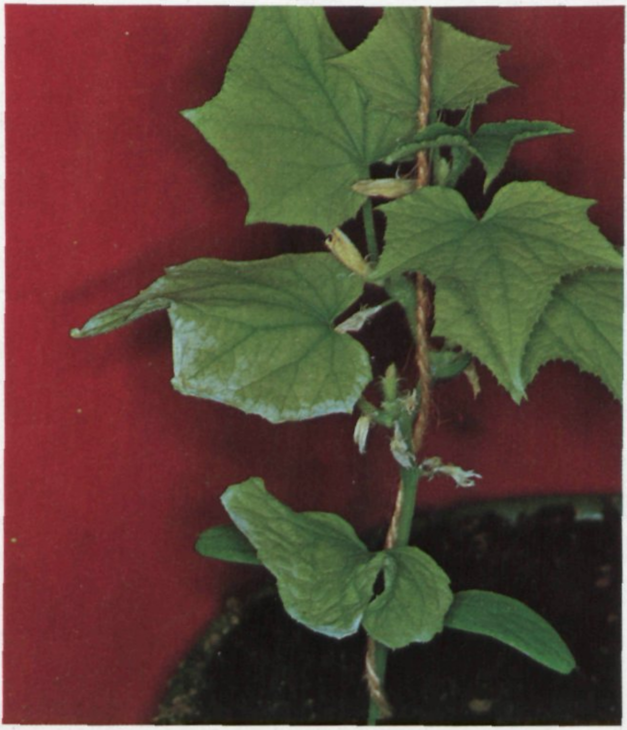
Leaves of cucumber plant (Sporu) grown on sphagnum peat; left healthy; right molybdenum-deficient.

Molybdenum deficiency

Symptoms The green colour of older leaves fades, particularly between the veins. Later, leaves turn pale green but for some green patches, 0.25-2 cm across, which include both veins and interveinal areas. Eventually, leaves turn yellow and die. These symptoms start in lower leaves and spread upwards, the youngest ones remaining green. Growth is rather normal but flowers are small. Blake (1959) gives a rather similar description.
The authors found 0.3 ppm Mo or less in leaf dry matter of molybdenum-starved plants and 0.8-3.3 ppm in healthy ones.

Incidence Molybdenum deficiency is unknown in Dutch commercial glasshouses. On sphagnum peat the disorder may be induced by insufficient liming and by applying ample nitrogen as nitrate.

Control Apply 5 g ammonium or sodium molybdate per m^3 sphagnum peat as preventive. To cure deficiency, apply 15 g molybdate fertilizer per 100 m^2 soil (1.35 lb/acre) in ample water or spray a 0.1% solution of molybdate fertilizer; according to Blake (1959) a 0.07% solution should be used.



Iron deficiency in a cucumber plant (Sporu) grown on sphagnum peat.

Leaves of cucumber plants (Sporu); left healthy; right iron-deficient.

Iron deficiency

Symptoms The youngest leaves exhibit a fine pattern of green veins on yellow leaf tissue. At first plants grow normally. In more advanced stages chlorosis spreads to the veins, first the smaller ones; affected leaves turn lemon-yellow to yellowish white. Shoots stop growing and necrosis appears at the edges of leaves that have lost chlorophyll completely. Unlike manganese deficiency, the youngest leaves are affected most and symptoms proceed from top to base. Axillary shoots and fruits also turn lemon-yellow.
The authors found 63 and 120-420 ppm Fe in dry matter of leaves of iron-deficient and healty plants, respectively. According to Will (1967) symptoms occur with values in the plant lower than 30 ppm Fe. Everett (1964) reports 15 ppm Fe for gherkin plants without and 108-280 ppm Fe for plants with trace elements applied.

Incidence Deficiency may be expected on calcareous soils with a bad structure. According to Will (1967) the disorder is promoted by a high phosphate status of the soil.

Control As a cure, apply chelates: 5-10 g Fe-EDDHA per m^2 (0.15-0.30 oz/yd^2) or 12-20 g Fe-DTPA per m^2 soil (0.35-0.60 oz/yd^2). Will (1967) recommends spraying with a 0.02-0.05% solution of Fe-EDTA every three or four days.

Zinc deficiency in the top of a cucumber plant (Sporu) grown in water culture.

Leaf of a zinc-deficient cucumber plant (Sporu) grown in water culture.

Zinc deficiency

Symptoms Slight interveinal mottling appears in older leaves, the pattern being coarser than in iron and manganese deficiency. Symptoms spread from older to younger leaves but are not severe; necrosis is not obvious. As top internodes stop growing, upper leaves are close together giving the plant a somewhat bushy appearance.
Leaves of zinc-deficient plants contained 9 ppm Zn in dry matter; leaves of healthy plants had 90-150 ppm.

Incidence Zinc deficiency is unknown in the Netherlands. The authors know no published reports on this disorder in cucumber or gherkin plants.

Control Spraying a solution of up to 0.5% zinc sulphate.

Cucumber (Sporu) leaf burn caused by too heavy an application of ammonium nitrate limestone.

Detail of leaf burn in cucumber.

Excess nitrogen

Symptoms Plants are dark green and growth is reduced. Middle and older leaves are curved and petioles droop slightly. Transparent spots between veins or at the edges coalesce and turn yellow to brownish grey. Affected leaves and petioles wilt, the older leaves first. Fruits are smaller than usual. In acute cases the entire plant collapses within a few days. Bergmann et al. (1965) give a rather similar description with illustrations.
Leaves of plants with chronic nitrogen excess contained 1.8% NO_3-N in dry matter. According to Nowosielski (1960) levels above 0.30-0.40% NO_3-N indicate excess nitrogen in gherkin plants.

Incidence Chronic symptoms occur on soils rich in readily soluble nitrogen, especially if insufficiently watered. Acute excess may be caused by too heavy dressings and uneven distribution of nitrogenous fertilizers; coarse-textured soils require special care.

Control Water plants amply and restrict transpiration as much as possible. Plants may recover if they do not wilt.

Gherkin plant (Levo) grown on sphagnum peat showing boron excess.

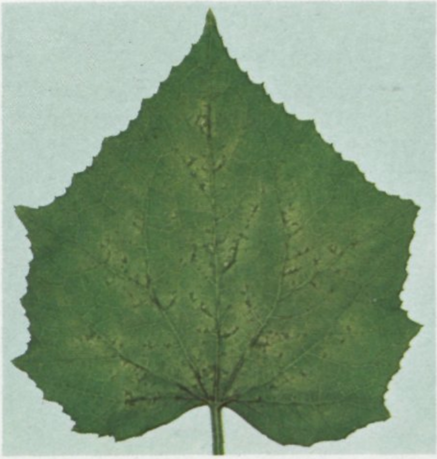
Boron excess in a cucumber leaf (Sporu) from a plant in water culture.

Excess boron

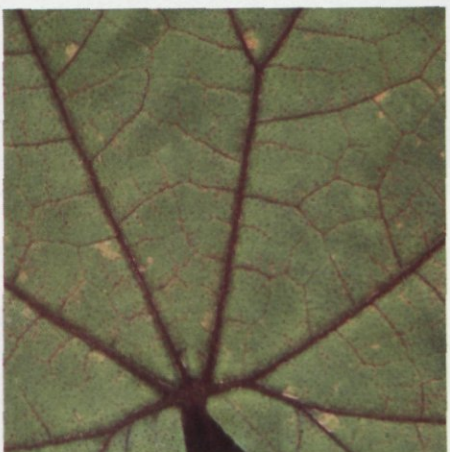
Symptoms Edges of older leaves discolour yellowish green, droop and wither. Leaves tend to cup downward and are more circular than usual. Symptoms spread from the base upwards, the oldest leaves being affected first. In more advanced stages necrotic spots develop between veins. These spots coalesce into large brownish transparent patches which feel papery, and finally the leaf withers. Growth is stunted, upper leaves remain small and few female flowers, if any, are produced. These symptoms are like those given by Bergmann et al. (1965) and Sanna (1967) for cucumber and gherkin crops, respectively. According to Sanna (1967) gherkins are more susceptible than cucumbers.
Leaves of plants with symptoms had 300-500 ppm B in dry matter. Bergmann et al. (1965) report 1340-3000 ppm B in edges and 600 ppm B in the rest of leaves from cucumbers. According to Sanna (1967) in gherkin plants toxicity appears with 30 ppm B in leaf dry matter.

Incidence Toxicity is easily caused by careless use of boron fertilizers. According to Sanna (1967) 8 g borax per m^3 peat substrate is toxic to gherkins.

Control Leach the soil, preferably with hard water. According to Bergmann et al. (1965) overhead sprinkling the plant leaches boron from the leaves. Probably plants can tolerate more boron at higher pH values; on acid soils liming is recommended.



Manganese excess in a gherkin leaf (Levo) from a plant on sphagnum peat.



Detail of a cucumber leaf (Sporu) showing manganese excess (red veins).

Excess manganese

Symptoms Veins of the oldest leaves turn dark red or reddish brown, and light green or transparent spots appear between veins. As discoloration advances, necrosis develops and leaves die. The symptoms proceed from lower leaves upwards. In severe toxicity plants are stunted and stems, petioles and leaves are covered by numerous purple dots.
Plants with toxicity had at least 682 ppm Mn in leaf dry matter. Manganese toxicity was reported by the Glasshouse Crops Research Institute at Littlehampton (Messing, 1963) when the young leaves had just over 500 ppm Mn; 1000 ppm or more was found in older fully expanded leaves.

Incidence Steaming releases much plant-available manganese and may induce toxicity in later crops, especially at low pH values (Sonneveld, 1968).

Control Lime the soil. This may not be necessary if the soil is heated at 60°-75°C, rather than at 100°C, by using steam-air mixtures (Dawson et al. 1965). Hansen (1967) claims that 20 g cobalt nitrate per 100 m^2 prevents toxicity after steaming.

Zinc excess in the top of a cucumber plant (Sporu) grown in water culture.

Excess zinc

Symptoms Plants are severely stunted. Chlorotic symptoms resembling those of iron deficiency, appear in the youngest leaves. Later, these symptoms spread to older leaves.
Tops of plants with toxicity had 900 ppm Zn in dry matter.

Incidence Toxicity has not been observed in commercial glasshouses. Rauterberg & Bussler (1964) report zinc toxicity in some crops grown in galvanized cages. The disorder might, therefore, occur in cucumber or gherkin crops grown in glasshouses with galvanized frames. Soilborne toxicity is possible near zinc and metal foundries (Henkens, 1961).

Control Apply lime and phosphate to reduce zinc availability to plants.

Chemical composition of fruits of healthy cucumber and gherkin plants.

	Values by the authors	Values in the literature	
% of fresh weight			
dry matter	3.3–3.7	3.0	(Wilkins, 1917)
		4.4	(Ward, 1967)
% in dry matter			
N	2.4–3.7		
NO_3-N	0.15	0.02–0.03	(Dearborn, 1936)
P_2O_5	1.7–2.0	1.0	(Wilkins, 1917)
		1.3	(Ward, 1967)
K_2O	5.5–9.1	3.2	(Bradley et al., 1961)
		4.3	(Ward, 1967)
CaO	0.9–1.5	0.6	(Wilkins, 1917)
		0.7	(Geisler & Kurnoth, 1959; Ward, 1967)
MgO	0.5–0.8	0.4	(Ward, 1967)
Na_2O	0.5	0.3 –0.9	(Wenkam & Miller, 1957)
Cl	1.4		
SiO_2	—	0.65	(Vogel & Weber, 1932)
ppm in dry matter			
Cu	8		
Fe	80		
Mn	33		
Zn	60		
B	25		
As	—	0.02–2.4	(Chapman, 1966)

Remy & Weiske (1930) and Roorda van Eysinga & Van Haeff (1964) mention values in accordance with those in the first column.

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