Растителна защита
електронно списание за растителна защита
семена, торове и земеделие
ISSN 2815-522X

Physiological changes caused by calcium deficiency or excess

Author(s): доц. д-р Венета Каназирска
Date: 24.04.2022 *Issue:* 4/2022

Are we able to "communicate with plants"?

Visual diagnostics

CALCIUM (Ca – Calcium from the Latin word calx, meaning lime)

Importance of calcium for plants

Calcium is a key regulator of the vital functions of the plant organism. It supports normal division of root cells and affects the deep growth of the root system. It plays a key role in regulating the active transport of potassium

ISSN 2815-522X

for stomatal opening, and of ammonium and nitrates. It is related to photosynthesis and plant growth.

It increases the strength of plant cells. Calcium is a key component of cell walls, helps build a strong structure and ensures cell stability. Calcium-enriched cell walls are more resistant to bacterial or fungal attack. It helps plants to better withstand heat stress.

It improves product quality and post-harvest shelf life.

Uptake

Calcium is taken up by plants throughout the entire period of active growth in the form of a calcium cation (Ca+).

Plant demand for calcium

The need for calcium arises as early as seed germination. It is important for the elongation of roots and shoots, as it actively participates in cell division. Soluble calcium must be continuously available from the beginning of vegetation in order to ensure proper shoot growth and better root architecture.

Calcium is present in all plant organs in the form of salts with organic and mineral acids or as compounds with the colloids of the cell plasma. Its quantity in different parts varies depending on the age of the plants and their organs. Calcium accumulates more in the vegetative organs – leaves, stems, and less in the reproductive organs – seeds, fruits.

Unlike nitrogen, phosphorus and potassium, it is not a mobile element and is not subject to redistribution (reutilization) within the plant organism.

CALCIUM DEFICIENCY

General symptoms – the first signs occur on young leaves and tissues.

Typical symptoms of calcium deficiency are yellow, curled upper leaves, tip burn and small chlorotic new leaves. The tips of the young leaves bend downwards as soon as they emerge from the buds, and their margins curl towards the upper or lower surface. They are small, distorted, with irregular shape and the edges are scorched or appear torn. Petioles are deformed.

In acute deficiency, apical buds die. Roots stop growing and are thickened, shortened, with a dark brown colour. Flowers drop. Product quality deteriorates. Fruits become smaller and have poorer taste. A classic symptom of

ISSN 2815-522X

calcium deficiency is blossom-end rot of fruits. The reason is that calcium accumulates more in the vegetative organs (leaves) and less in the fruits. The affected tissue becomes dark, sunken and is often secondarily infected by saprophytic fungi. Only under a favourable regime of calcium supply to plants can its deficiency in the fruits be prevented.

Nutritional disorders related to calcium are mainly triggered by unfavourable growing conditions – climatic factors, drying of the growing medium (soil, substrate), nutritional imbalance and/or high salt concentration of the growing medium.

Causes

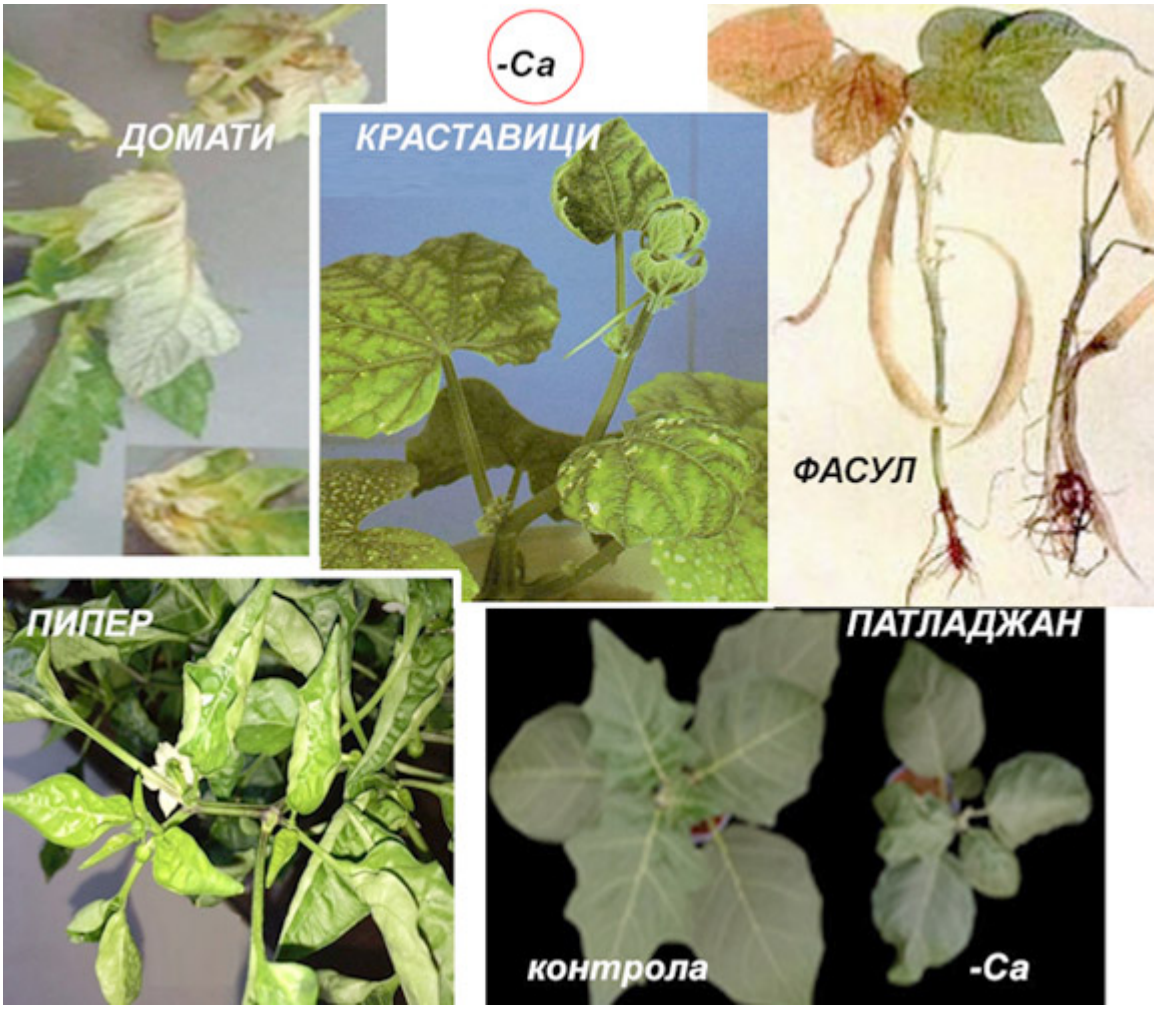
Disorders in plant nutrition with calcium are rarely due to low calcium levels in the growing medium, especially in soil culture. They are usually caused by factors that hinder its uptake by plants: very high content of ammonium nitrogen, potassium and/or magnesium, sodium and/or aluminium; low boron content in the growing medium; high salt concentration; acidic reaction (pH < 5.0); drying or waterlogging of the medium; high air temperature (especially at night); foggy weather. Other factors include irregular irrigation (drought followed by waterlogging), rapid plant growth due to high nitrogen fertilization levels.

Recommendations

Liming in acidic soils; application of calcium nitrate or superphosphate based on soil analysis. In hydroponic culture, use of a solution containing 150 ppm Ca and maintenance of salt concentration in the growing medium at about 1.8 – 2.0 mS/cm. Adjustment of the irrigation regime. Foliar feeding with 1.0% calcium nitrate or with other products containing calcium provides the fastest result.

Identification of symptoms of calcium deficiency by crop

ISSN 2815-522X



Calcium deficiency in fruit vegetable crops

Calcium deficiency (actual or induced) is the cause of blossom-end rot in fruits

Symptoms of calcium deficiency in fruit vegetable crops:

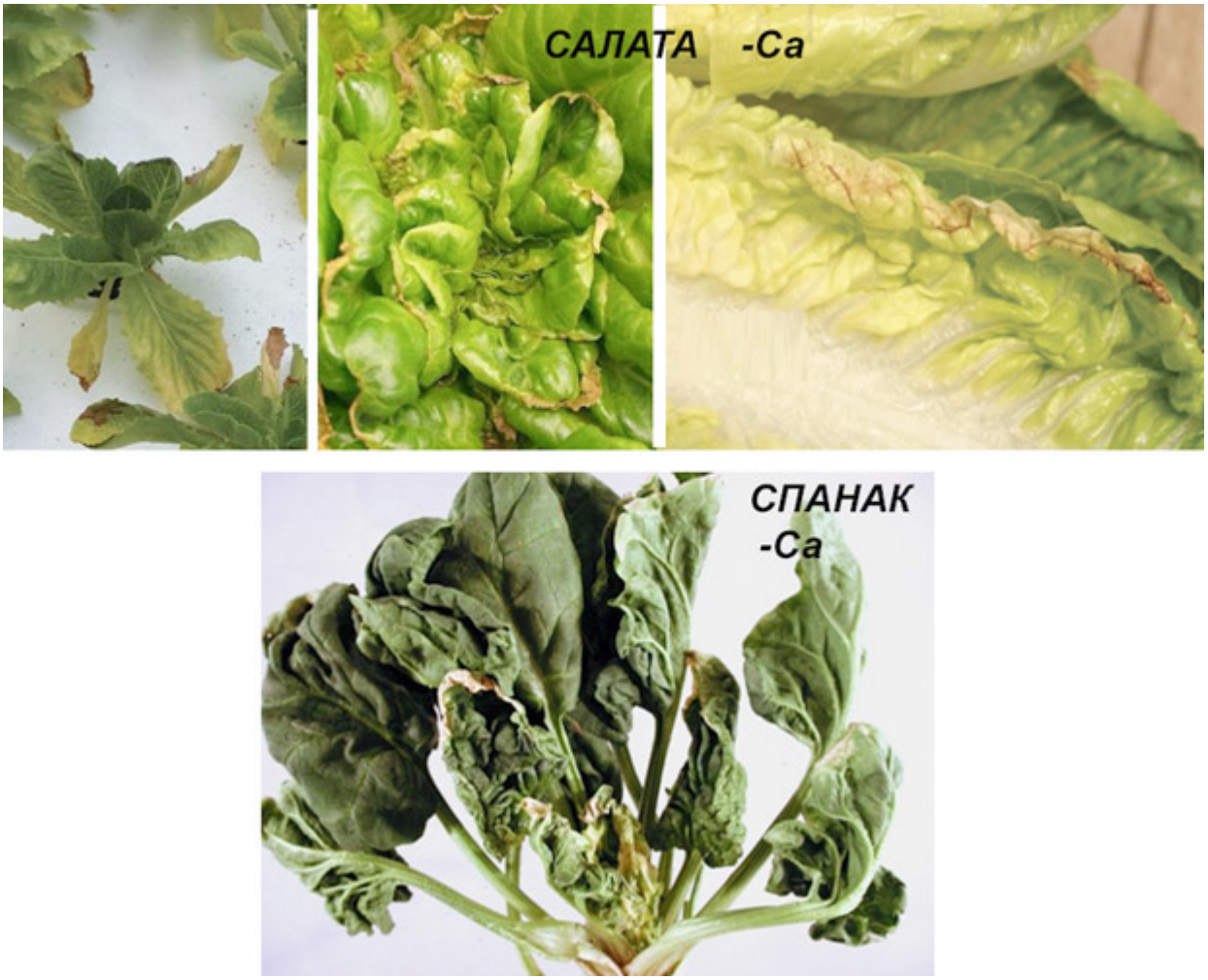
- The upper side of young leaves is initially dark green with pale margins. White spots appear between the veins. Main veins remain green. Leaves are small, deformed, curled. Subsequently, their tips and margins dry out. Older leaves also curl downwards. In severe deficiency, petioles are brittle and leaves drop easily;

- Growth stops. Internodes are shortened, especially near the top. Growing points die. Flowers drop;

- Fruit quality deteriorates: fruits are small; blossom-end rot appears and they ripen prematurely; the affected tissue is often secondarily infected with saprophytic fungi;

- Yield of marketable produce is low.

ISSN 2815-522X



Calcium deficiency in leafy vegetable crops

Symptoms of calcium deficiency in leafy vegetable crops:

- Symptoms of calcium deficiency initially appear as localized tissue necrosis, leading to stunted plant growth, necrotic margins of young leaves, leaf curling;

- Growing root tips die;

- New growth and rapidly growing tissues of the plant are affected;

- New leaves stick together at the edges and become distorted. Chlorosis develops;

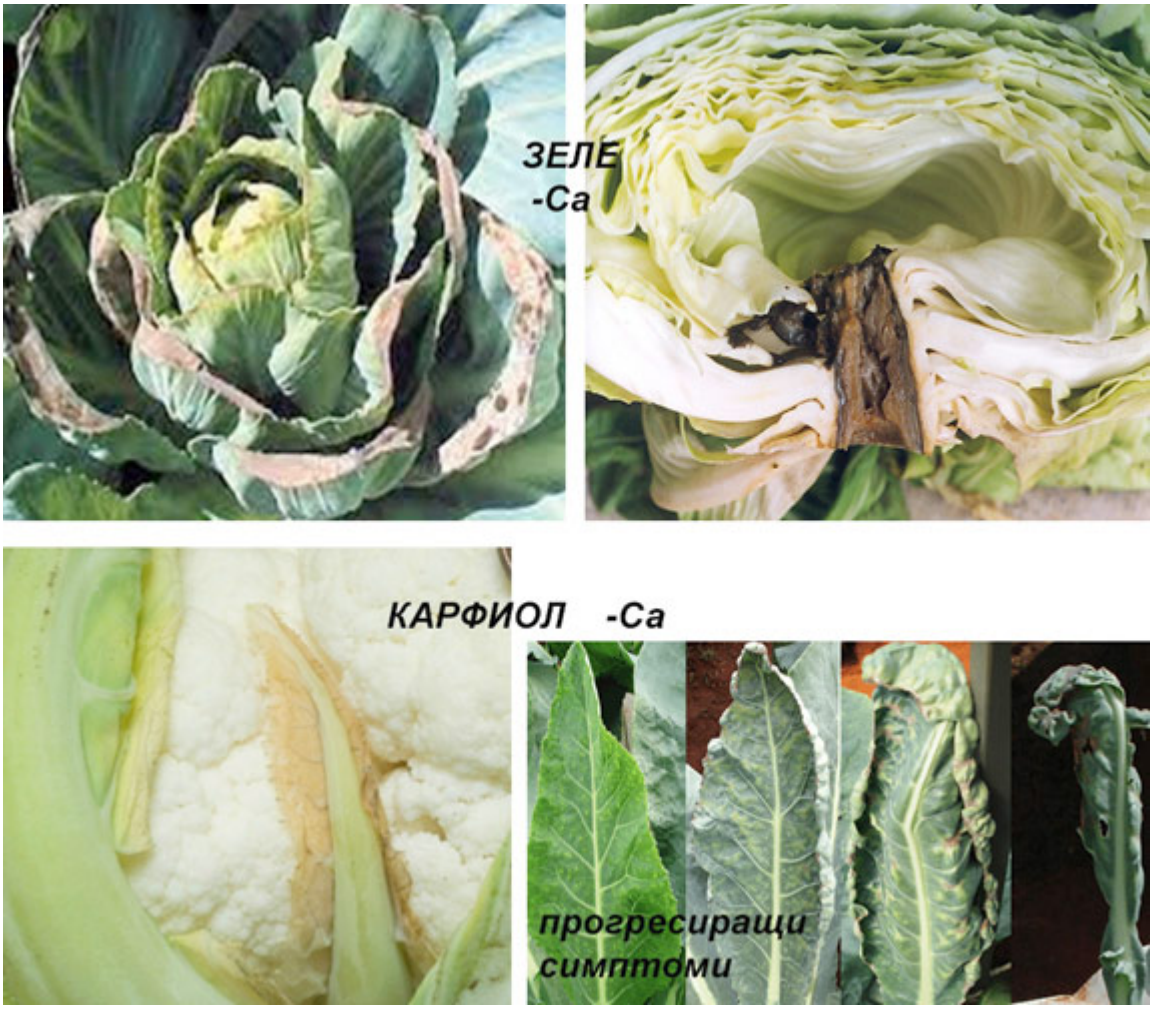
- Most often, in the last weeks before harvest, small translucent spots appear on the periphery of the inner leaves, followed by scorch. Mature leaves are rarely affected, as calcium accumulates in them to high concentrations;

ISSN 2815-522X

- The sensitivity of cultivars to calcium deficiency varies. Some cultivars react even to slight drying of the substrate, which hinders calcium uptake;

- Growth is retarded, plant height reduced, with fewer nodes and smaller leaf area. Leaves are curled and veins are dark. Growth points die, leading to branching;

- Yield and quality are reduced.



Calcium deficiency in leaf-stem vegetable crops

Symptoms of calcium deficiency in leaf-stem vegetable crops:

- If calcium deficiency occurs in the early stages, growth is delayed and heads do not form;

- A specific symptom is tip burn of young leaves. With progressing deficiency, necrosis extends inwards;

- Calcium deficiency is one of the causes of stem rot (black heart);

ISSN 2815-522X

- Individual flower buds in broccoli turn brown and die under hot and dry conditions. The problem is related to calcium uptake and distribution in the plant combined with rapid growth;

- Yield of quality produce is reduced.

Calcium deficiency in bulb vegetable crops

Symptoms of calcium deficiency in bulb vegetable crops:

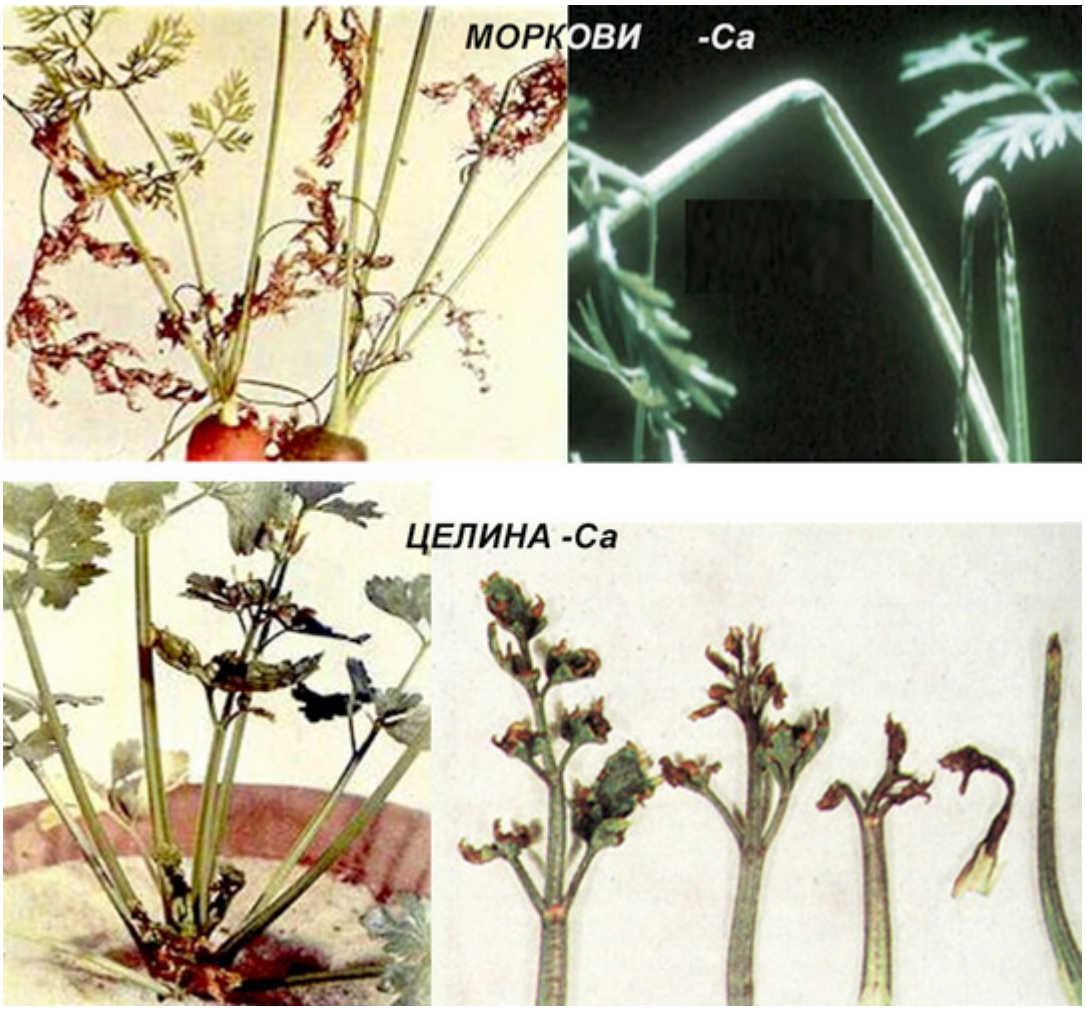
- In onion, new leaves are short, and in leek – strongly narrowed. Leaves die without yellowing, which leads to plant death;

- In other cases, chlorosis appears. Leaves become almost white and curled.

- Bulb quality deteriorates (bulbs are small);

- Storage life is reduced;

- Growth is retarded.



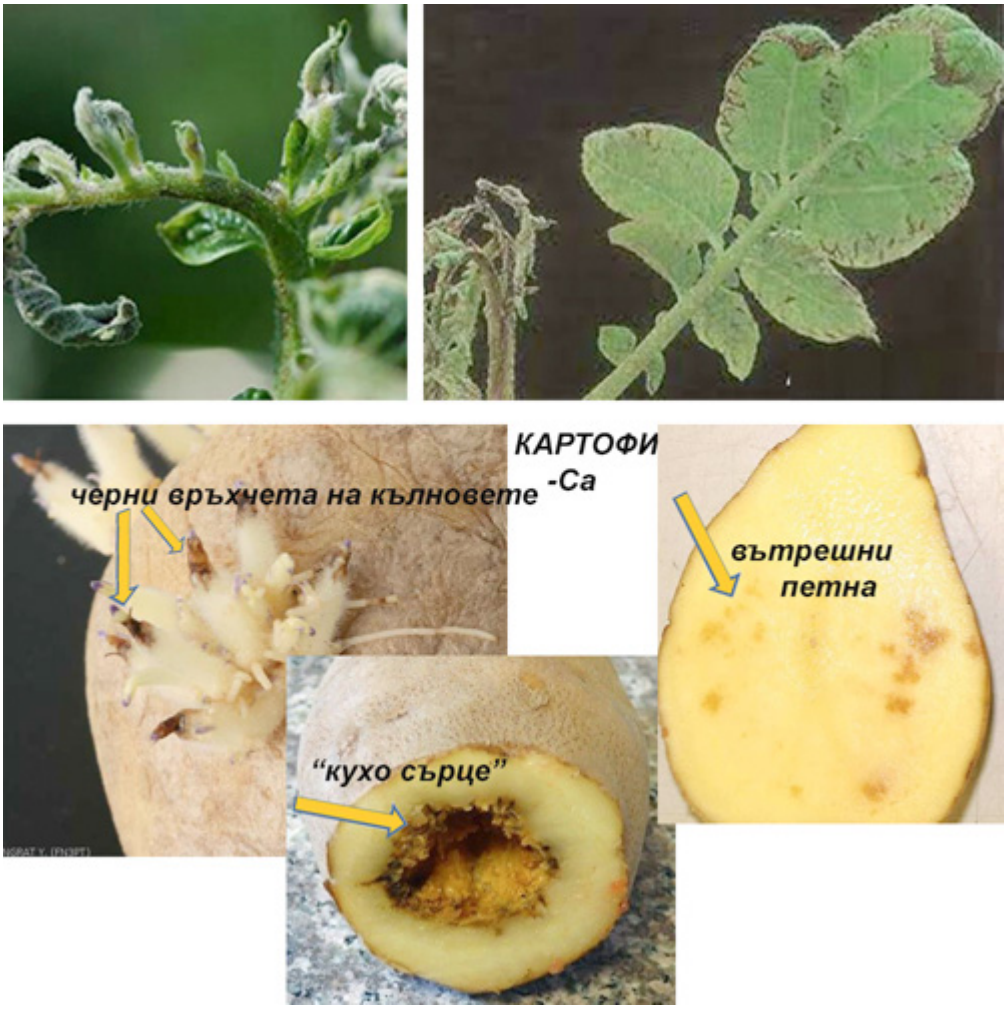
Calcium deficiency in root vegetable crops

Symptoms of calcium deficiency in root vegetable crops:

- Growth is slowed. Young leaves are deformed, curled and small;

- In acute deficiency, leaf petioles of carrots dry out, and in celery scorch appears on the margins of young leaves and growth points die;

- Under calcium deficiency, root crop quality deteriorates – in carrots cavities appear, and in celery the core turns black.



Calcium deficiency in tuber vegetable crops

Symptoms of calcium deficiency in tuber vegetable crops:

- Growth is slowed. In case of severe and/or prolonged calcium deficiency, production may be delayed;

- Young leaves and leaf tips become chlorotic, smaller and slightly curled;

- Necrotic and black tips appear on sprouts;

- Tuber quality, transportability (risk of bruising increases) and storability are reduced;

- Internal “rust spot” develops in tubers, for which one of the causes is calcium deficiency;

- So-called “hollow heart” appears, which is caused by an abrupt change in tuber growth rate under stress conditions (sudden change in water and/or temperature regime, fertilizer over-application) and the associated calcium deficiency. Externally, such potatoes do not differ from quality ones until they are cut.

ISSN 2815-522X

CALCIUM EXCESS

General symptoms

Calcium is not directly toxic to plants. Problems caused by excess calcium are due to the alkaline reaction of the growing medium and/or its antagonistic effect on the uptake of other nutrients by plants – potassium, magnesium, boron, copper, iron and zinc. Therefore, symptoms of deficiency of these elements appear.

With excess calcium, many plants undergo metabolic changes that cause interveinal chlorosis. Spots are pale and necrotic. In some crops these spots are coloured or water-soaked concentric circles appear in them. In other cases, intensive growth of the leaf rosette begins.

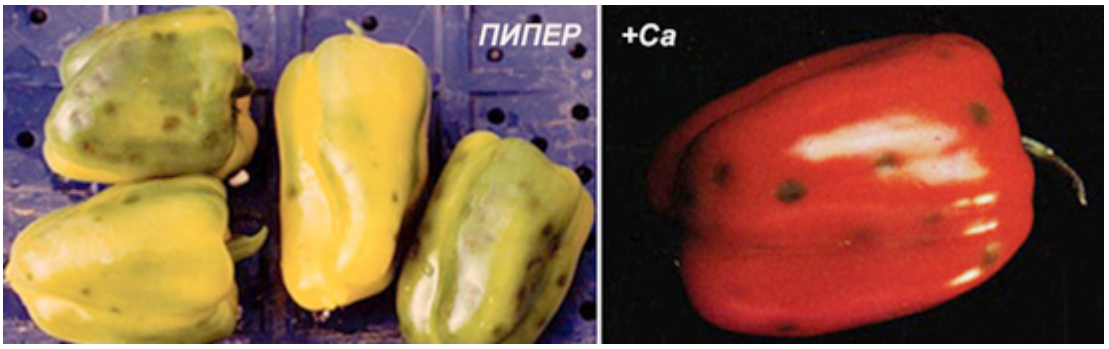
Cause

Incorrect liming of soil (alkaline reaction); use of irrigation water with high hardness; over-application of calcium-containing fertilizers

Recommendation

Fertilization with potassium and/or magnesium fertilizers based on soil analysis; foliar feeding with 0.1% manganese sulphate. In hydroponic culture, use of a nutrient solution containing 200 ppm K and 30 ppm Mg.

Identification of symptoms of calcium excess by crop



Calcium excess in fruit vegetable crops

Symptoms of calcium excess in fruit vegetable crops:

- In addition to the general symptoms caused by calcium excess, as a result of its antagonism with potassium, magnesium, boron, copper, iron and zinc, product quality deteriorates – it causes spots on the fruits due to the

ISSN 2815-522X

formation of calcium oxalate crystals. On the fruit surface, under the skin, grey to black or brown-black dots appear singly or in groups. When fruits ripen, the spots become green or yellow.