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Physiological changes caused by magnesium deficiency or excess

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Do we know how to “communicate with plants"?

Visual diagnostics

MAGNESIUM (Mg – Magnesium)

Importance of magnesium for plants

In the plant organism, magnesium is present in the form of organic and mineral compounds. It is the central atom in the chlorophyll molecule. This determines its key role in the process of photosynthesis. The chlorophyll

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molecule contains 2.7% Mg.

Magnesium participates in the synthesis of nucleoproteins, fats and ascorbic acid, in carbohydrate metabolism and in phosphorylation reactions. It regulates the uptake of nutrients and water by the plant roots. It activates the state of enzymes, but does not take part in enzymatic reactions. As an activator of enzymes, its role in carbohydrate metabolism is expressed in facilitating the breakdown of glucose and phosphoric acid. This role can explain the fact that, when magnesium is deficient in the nutrient medium, the content of invert sugar in fruits and vegetables is significantly reduced.

Almost all processes of energy transfer and transformation associated with phosphorylation reactions require the presence of magnesium. The metabolism of magnesium and phosphorus is interconnected. It also improves the uptake of iron.

Plant requirements for magnesium

The total magnesium content in the plant depends on the species. For example, cucumbers remove on average 5–6 kg MgO/da, tomatoes – 6–8 kg MgO/da. Magnesium accumulates in different quantities in the various organs. Larger amounts accumulate in the seeds and in young, actively growing tissues.

The degree of magnesium supply to plants is manifested more sharply in the rate of development than in the formation of total plant biomass. It stimulates the formation of generative organs and increases seed germination and the growth energy of young plants. As plants proceed to the stages of budding, flowering and fruit set, the outflow of magnesium from the leaves to the generative organs intensifies.

Uptake

Plants take up magnesium from the nutrient medium in the form of the magnesium cation Mg^{2+}, which is why water-soluble magnesium salts are the most available to plants.

MAGNESIUM DEFICIENCY

General symptoms – the first signs appear on the lower leaves

Magnesium is a mobile element. Deficiency symptoms spread from the lower leaves and cover the middle part of the plant, and in cases of severe deficiency – the top as well.

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Magnesium deficiency causes a characteristic mottled chlorosis, in which the leaves acquire a variegated appearance – the areas between the veins fade, while the veins remain green. Magnesium from the lower leaves moves towards the upper ones along the veins, which is why the veins and the tissues adjacent to them are richer in magnesium and chlorophyll. These areas of the leaves, depending on the crop and even on the variety, may be pale green, light yellow, orange, red or violet. In more severe magnesium starvation, metabolism is disrupted, which leads to necrosis. Leaves drop prematurely.

Symptoms vary among different crops, but typically chlorosis begins at the tips of the older leaves and progresses along the leaf margins inward towards the petiole.

Once deficiency symptoms appear, they are difficult to correct.

Causes

Impaired nutrient regime – magnesium deficiency; high potassium content; high calcium content (in soil culture after liming); high level of ammonium nitrogen; low pH (< 5.0); poor aeration of the nutrient medium.

Recommendation

Fertilization with magnesium sulfate 10–20 kg/da; use of nitrate nitrogen fertilizers; in hydroponic culture – use of a solution with 35–40 ppm Mg; application of foliar fertilizers containing magnesium.

Identification of magnesium deficiency symptoms by crop

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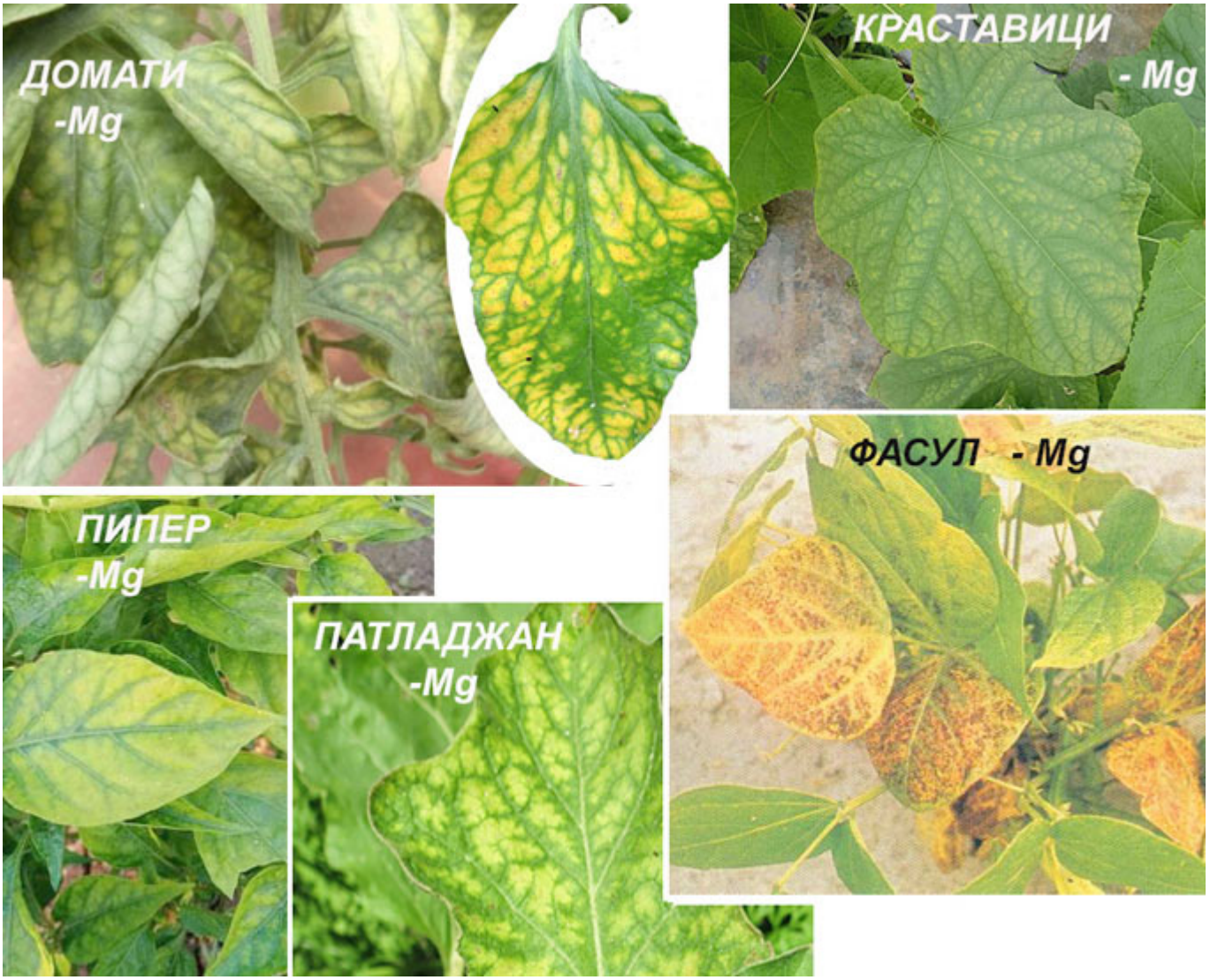

Magnesium deficiency in fruit vegetable crops

Symptoms of magnesium deficiency in fruit vegetable crops:

- The leaf margins become discoloured, including the interveinal tissue and the smallest veins. In severe deficiency, chlorosis also affects the central veins, with only the main veins remaining green;

- In the light yellow to orange leaf tissues, necrotic spots often appear, which may merge into brown streaks between the veins;

- The leaves shrivel. Their margins are torn. Symptoms spread to the younger leaves. Gradually the older leaves die and the whole plant turns yellow;

- Root system development is impaired;

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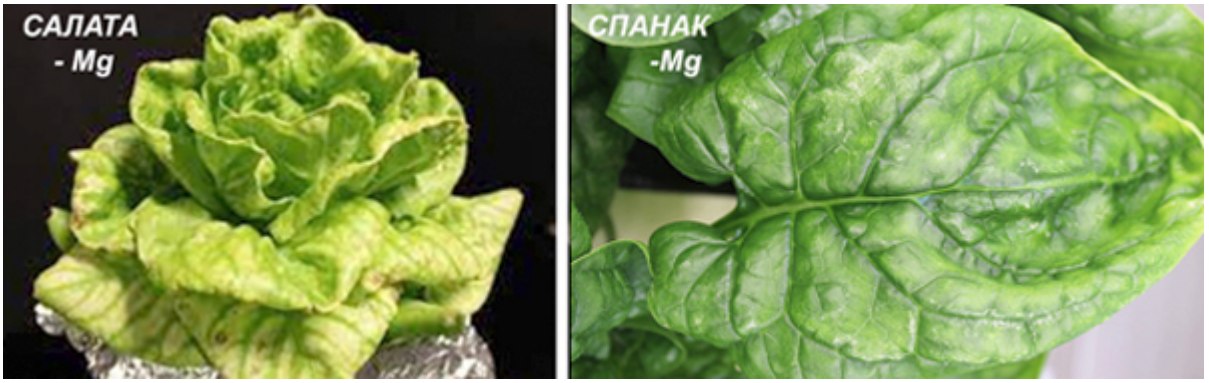
- Fruit set is reduced. Fruits remain small and may drop off;

- Product quality deteriorates;

- Ripening is delayed.



Magnesium deficiency in leafy vegetable crops

Symptoms of magnesium deficiency in fruit vegetable crops:

- Symptoms begin with slight interveinal chlorosis on the older leaves, which gradually covers the leaf surface and spreads to the younger leaves;

- Scattered necrotic spots also appear;

- Growth is suppressed.

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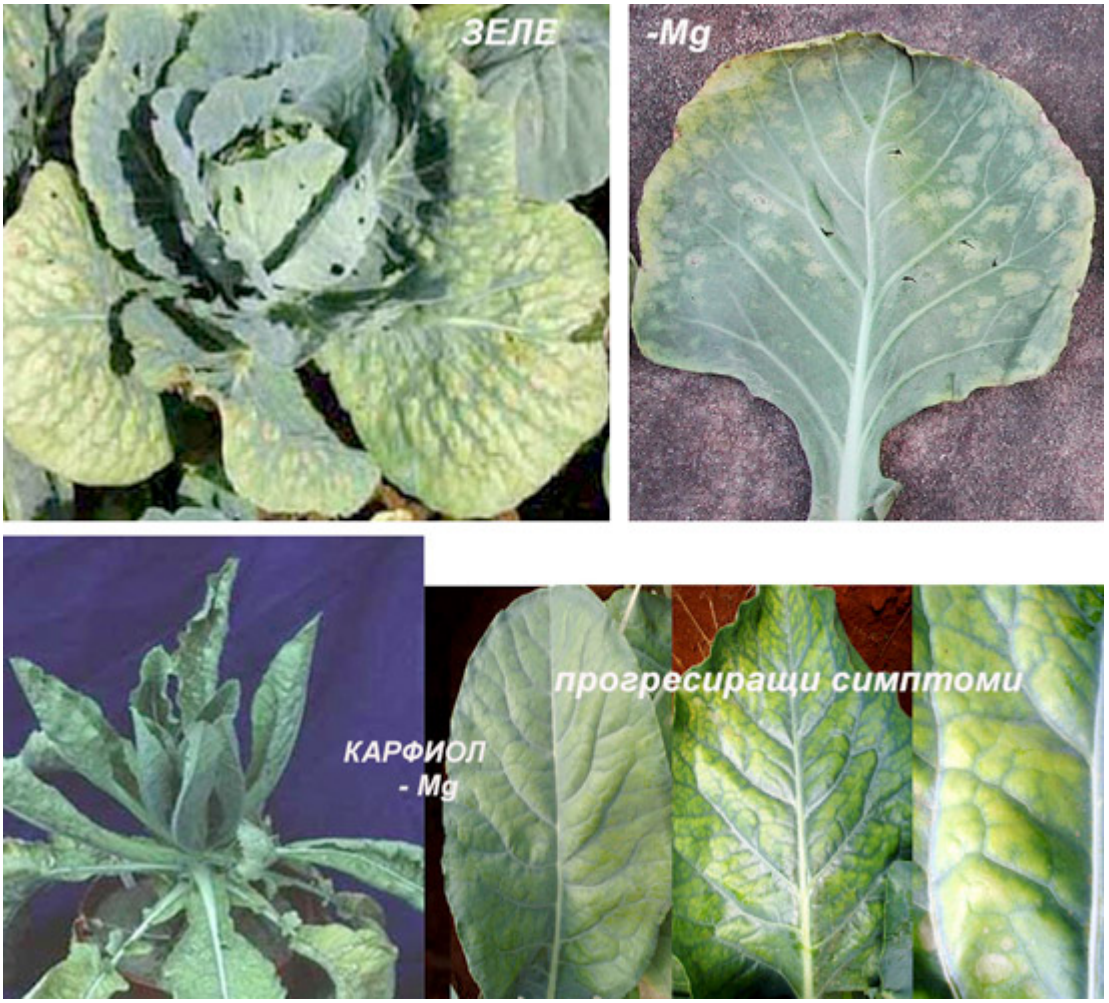

Magnesium deficiency in leaf-stem vegetable crops

Symptoms of magnesium deficiency in leaf-stem vegetable crops:

- Interveinal chlorosis develops on the older leaves, which extends and affects their margins. The veins remain green. With progressing deficiency, the smallest veins fade;

- Red or brown spots appear on the leaves. The leaf becomes deformed. Chlorosis covers the entire leaf and it dies;

- Root system growth is restricted.

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Magnesium deficiency in bulb vegetable crops

Symptoms of magnesium deficiency in bulb vegetable crops:

- The older leaves of onion become uniformly yellow along their entire length, while in leek they become yellowish green;

- Plants are thin, weak and chlorotic;

- With prolonged deficiency, the leaves turn brown and die;

- Slow growth of aboveground and underground parts.

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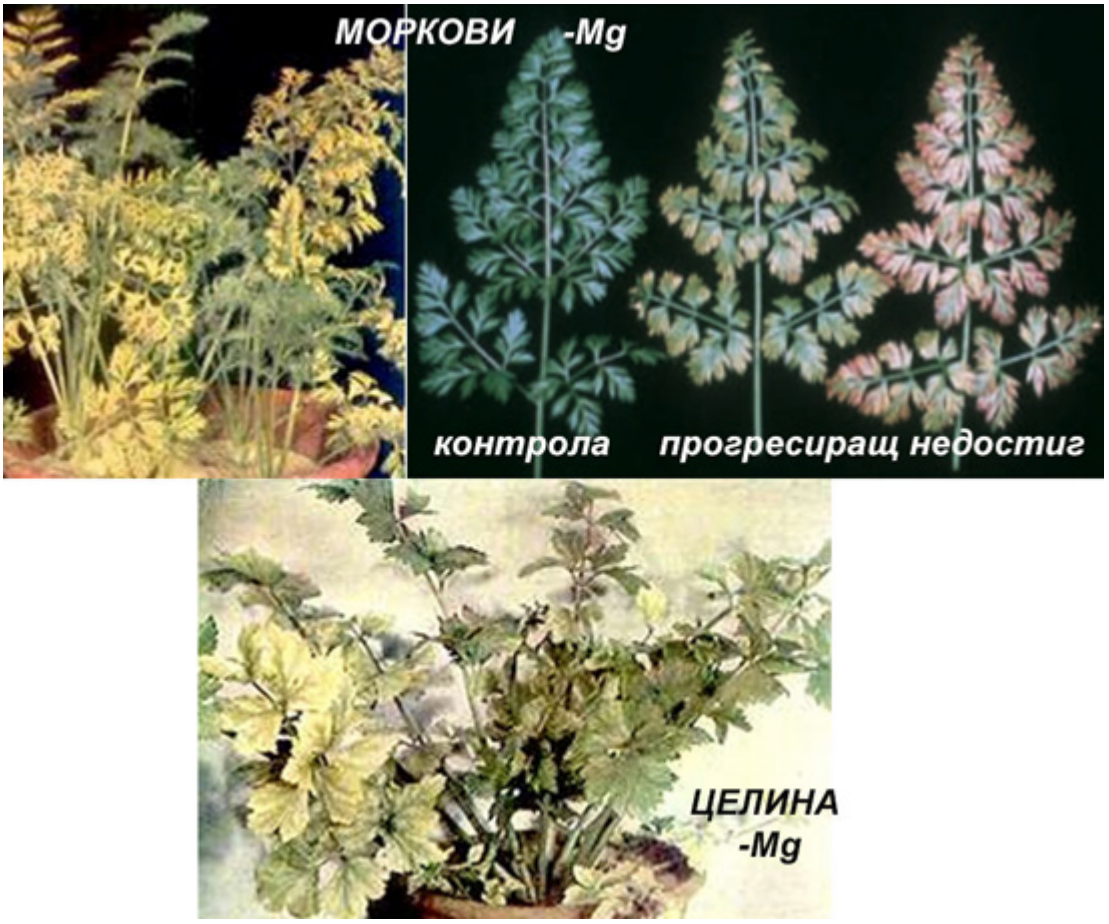

Magnesium deficiency in root vegetable crops

Symptoms of magnesium deficiency in root vegetable crops:

- The older leaves become chlorotic. Red tints appear;

- The margins of the older leaves turn yellowish orange;

- Growth is slowed.

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Magnesium deficiency in tuber vegetable crops

Symptoms of magnesium deficiency in tuber vegetable crops:

- The older leaves turn yellow between the veins and along the margins. Subsequently the yellow areas may become red, purple or brown;

- Product quality is reduced and tubers often accumulate nitrates;

- Growth slows down, leading to reduced yield.

MAGNESIUM EXCESS

General symptoms

Magnesium toxicity is a rare phenomenon. The first visual changes are due to potassium and calcium deficiency as a result of their hindered uptake by plants because of the antagonism between magnesium ions and these elements, i.e. the symptoms of magnesium toxicity are closely related to the symptoms of potassium or calcium deficiency.

Leaves are darker green than normal. Sometimes abnormal curling and wrinkling of the young leaves is observed.

Causes

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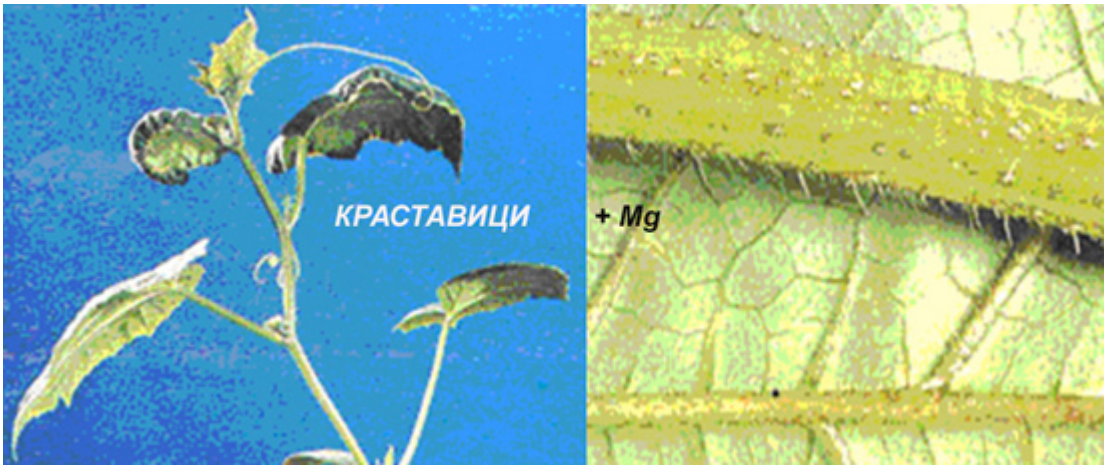
High level of magnesium in the nutrient medium; use of irrigation water with high magnesium content without the necessary correction of its mineral composition.

Recommendation

Fertilization with potassium and/or calcium fertilizers based on soil analysis. In hydroponic culture – use of a solution containing 290 ppm K and/or 150 ppm Ca. Foliar feeding with 1.5% potassium sulfate.

Identification of magnesium excess symptoms by crop



Magnesium excess in fruit vegetable crops

Symptoms of magnesium excess in fruit vegetable crops:

- Leaves are darker green. Sometimes abnormal curling and wrinkling of the young leaves is observed;

- Uptake of potassium and/or calcium is hindered and, as a result, deficiency of these elements occurs;

- Yield is reduced.