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

Physiological changes caused by potassium deficiency or excess

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Do we know how to "talk to plants"?

Visual diagnostics

POTASSIUM (K – Potassium from Neo-Latin: Kalium)

Importance of potassium for plants

Potassium is a macronutrient element. Unlike nitrogen and phosphorus, it does not participate in the composition of structural organic compounds, but is present in a free state, dissolved in the cell sap. It performs

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numerous physiological and biochemical functions in the plant. It regulates nitrogen activity – improves its uptake and utilization in the plant organism. It strongly reduces the accumulation of ammonium and nitrate nitrogen in plants, which is why it is considered an antidote to excessive nitrogen fertilization. It is unconditionally necessary for the action of enzymes that catalyse certain reactions of carbohydrate and nitrogen metabolism – it enhances the synthesis of proteins; the formation, decomposition and translocation of starch and carbohydrates. It influences photosynthesis, protein synthesis, activates various enzymes that participate in the formation of sugars, starch, aromatic, flavour and colouring substances.

A specific role of potassium in the plant organism is that it takes part in processes related to energy transformation. It coordinates the movement of the stomatal apparatus and the water regime. It has a beneficial effect on the water regime and turgor of plants.

It increases the resistance of plants to unfavourable (stress) conditions: low and high temperatures, drought, etc. It strengthens plant resistance to bacterial and fungal disease pathogens. It improves product quality. Plants adequately supplied with potassium produce larger, better-coloured yield and have increased resistance during transport and storage.

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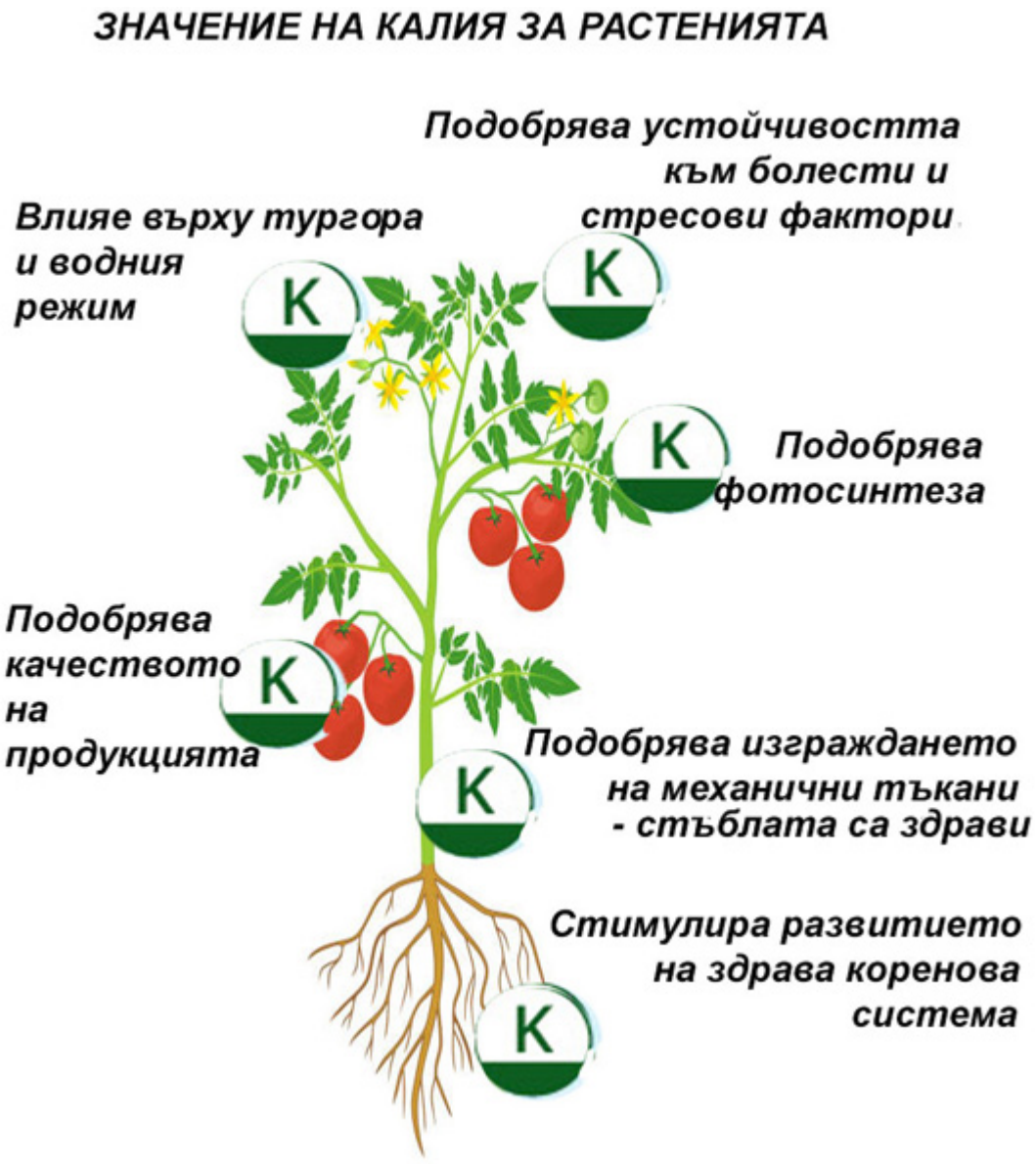

Plant requirements for potassium

The potassium content in plants varies within very wide limits, 0.5–6.0%. Young plants contain 3–5 times more potassium than older ones. Potassium is higher in organs and tissues in which there are active processes of metabolism and cell division. Its main part is in the vegetative organs. In most crops it is taken up more intensively in the initial growth stages.

Uptake

Plants take up potassium in the form of a cation (K+), therefore only water-soluble potassium salts are available to plants.

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POTASSIUM DEFICIENCY

General symptoms – the first symptoms appear on the lower or older leaves

Potassium is a mobile macronutrient element. Deficiency symptoms spread from the bottom upwards. Initially, potassium deficiency manifests itself as dark green leaves with a bluish tinge, due to the larger amounts of chlorophyll formed as a result of the accumulation of more nitrogen under these conditions. In more severe potassium deficiency, ammonium nitrogen accumulates in plant cells due to its weak conversion into amino acids. This leads to yellowing and death of tissues. Chlorosis begins at the leaf tip, spreads along the margins and then towards the middle between the veins. Leaves are often curled, appear scorched and fall prematurely.

Potassium starvation affects plant turgor. Even with abundant irrigation they wilt. The formation of mechanical tissues is impaired, so stems are not strong, leaves grow unevenly and become wrinkled. The appearance and taste qualities of the produce deteriorate.

Causes

Low potassium content in the nutrient medium; high calcium and/or magnesium content; high nitrogen content; heavy, compacted nutrient medium (soil, substrate); waterlogging and/or drought; alkaline medium.

Recommendations

Soil top-dressing with K2O 30–40 kg/da or application of liquid manure 0.8–1.0 t/da, and in hydroponics – use of a nutrient solution containing 290–300 ppm K. Foliar feeding with potassium sulphate 1.5%.

Identification of potassium deficiency symptoms by crop

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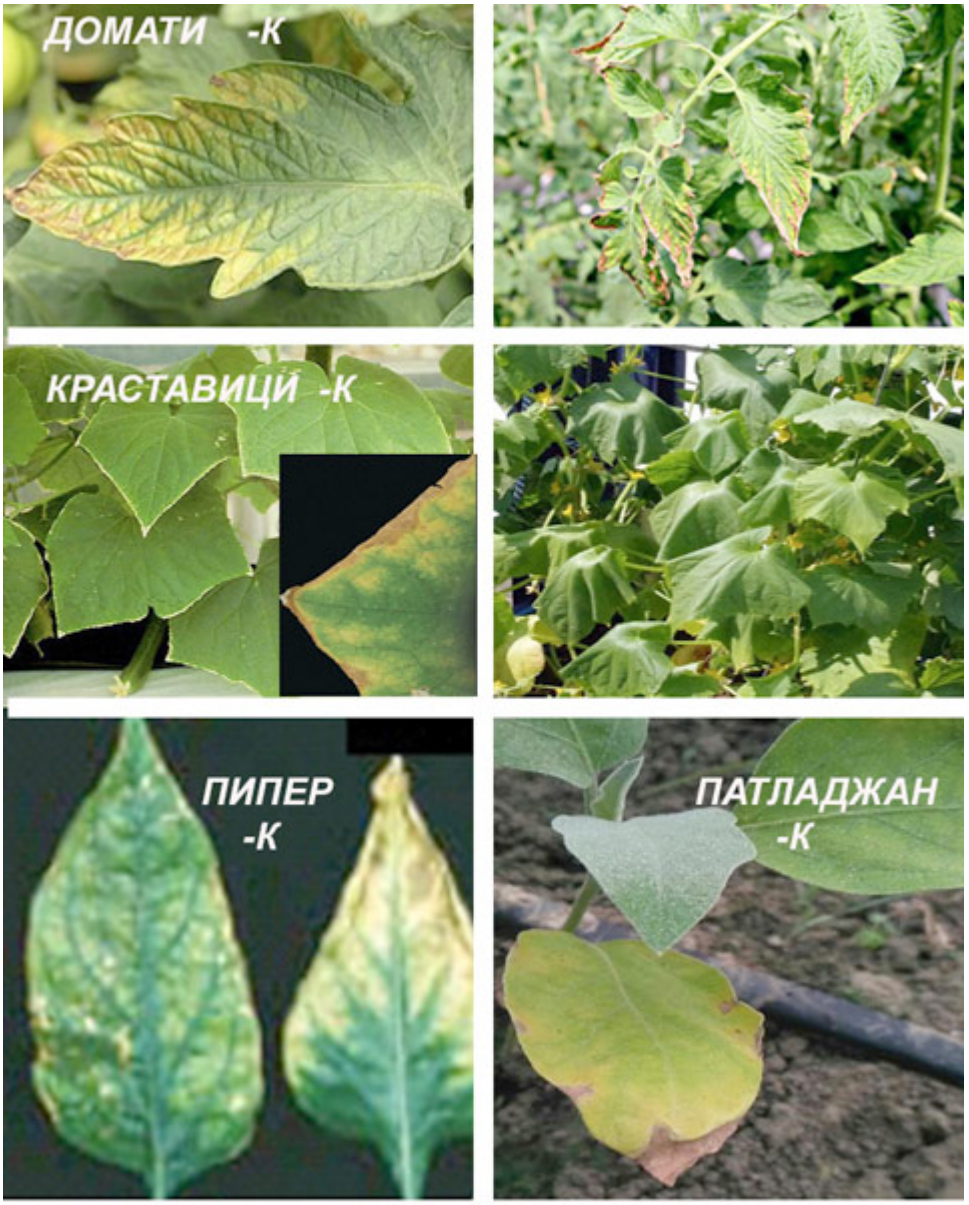

Potassium deficiency in fruit vegetable crops

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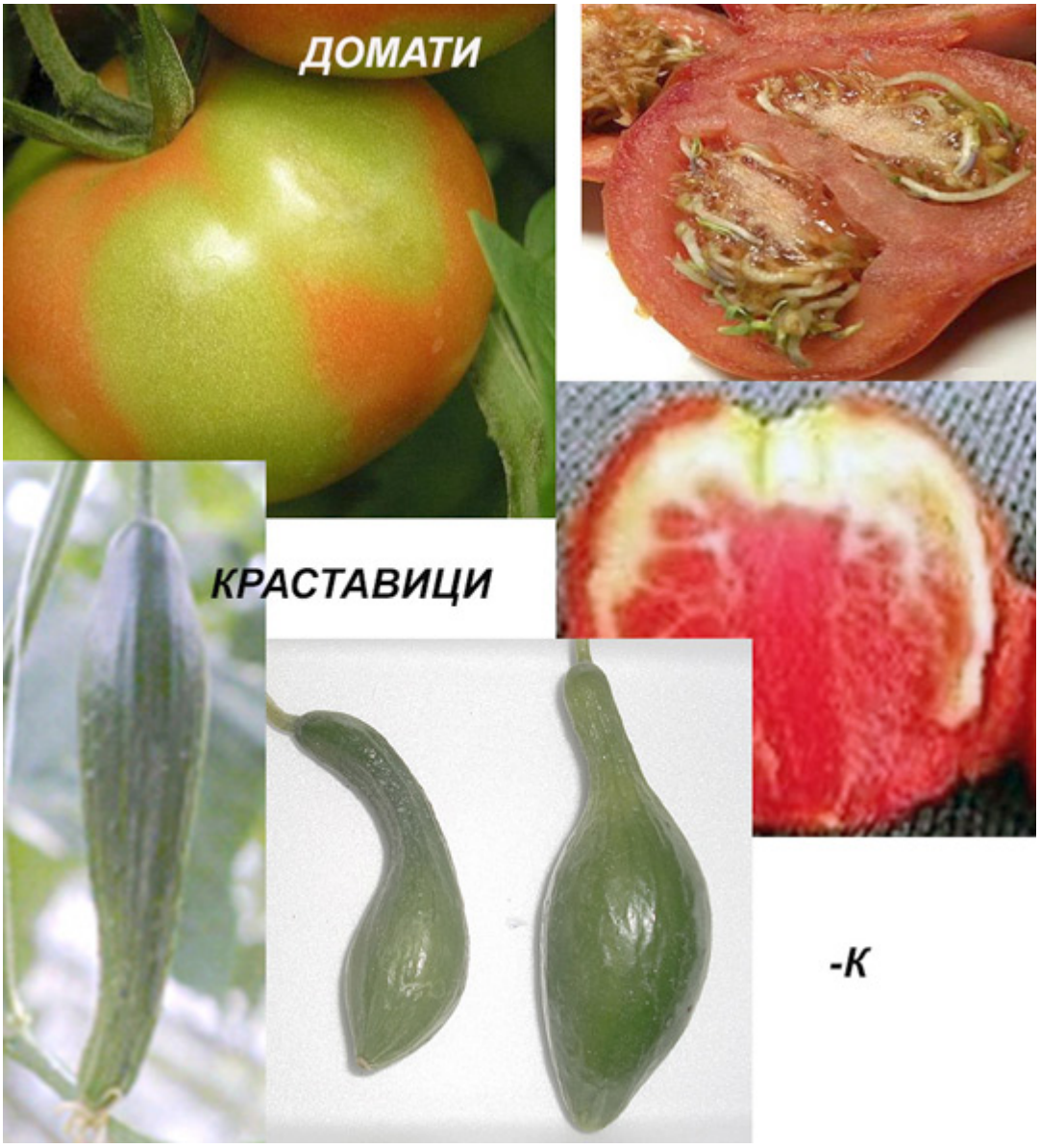


Potassium deficiency severely deteriorates product quality

Symptoms of potassium deficiency in fruit vegetable crops:

- Growth is retarded. Stems are weak and lateral branches are poorly developed;

- Older leaves develop interveinal chlorosis, with the smallest veins fading, while the main vein remains green. Leaf margins become necrotic and curl. Brown necrotic lesions develop in the yellow parts of the leaf and gradually cover it entirely. Necrosis associated with K deficiency is usually dark in colour and the necrotic areas become dry and brittle;

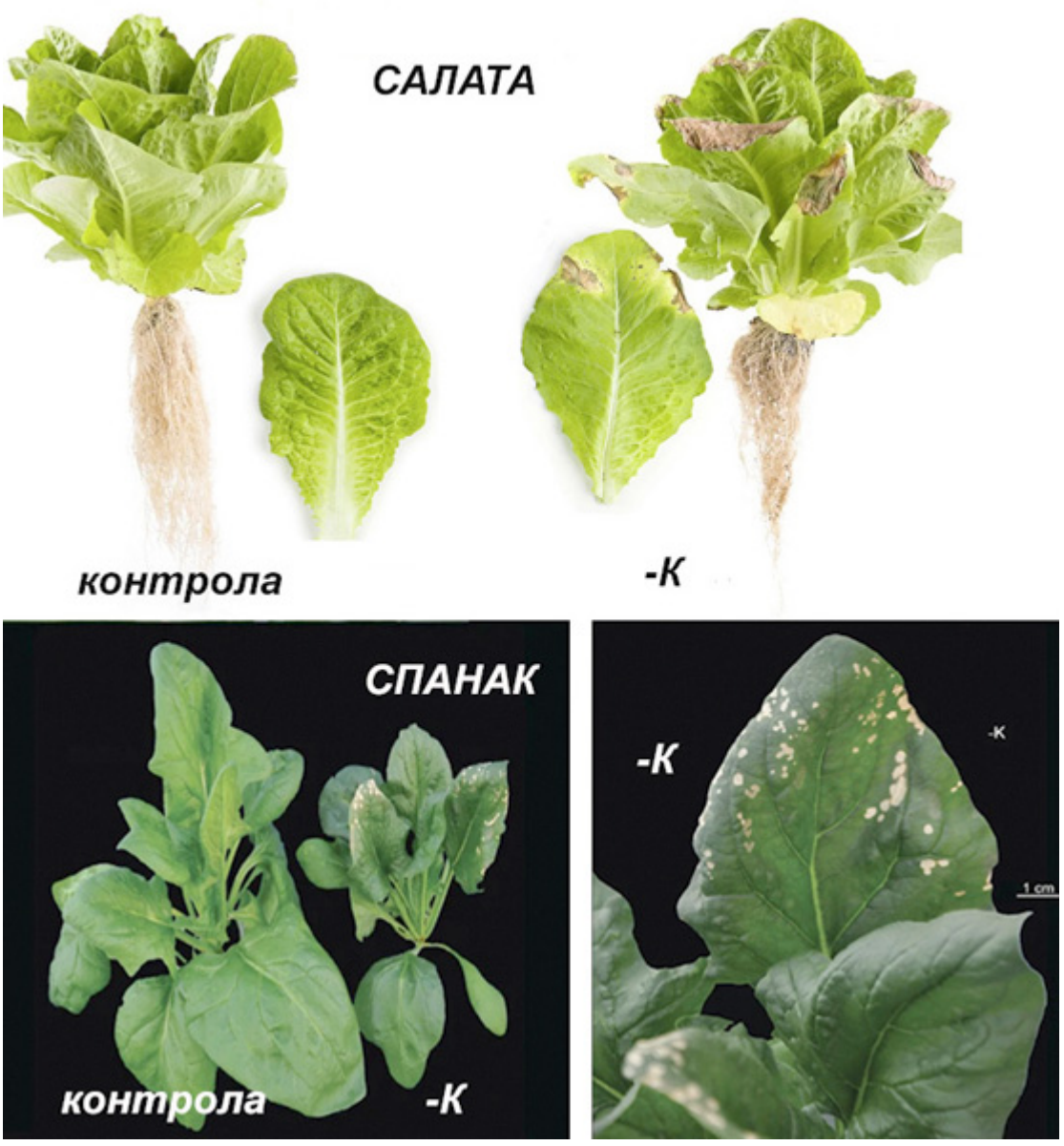
- Lack of potassium hampers pollination and fertilization processes;

- Fruits are of reduced quality – during ripening tomatoes are unevenly coloured, a green ring appears and/or seeds germinate prematurely inside the fruit; the fruit is soft, puffy with a mushy or mealy texture; cucumbers are unevenly coloured and/or deformed; brown spots appear on pepper fruits;

- Turgor deteriorates and plants wilt during the sunny hours of the day;

- Growth is retarded;

- Yield of quality produce is reduced.



Potassium deficiency in leafy vegetable crops

Symptoms of potassium deficiency in leafy vegetable crops:

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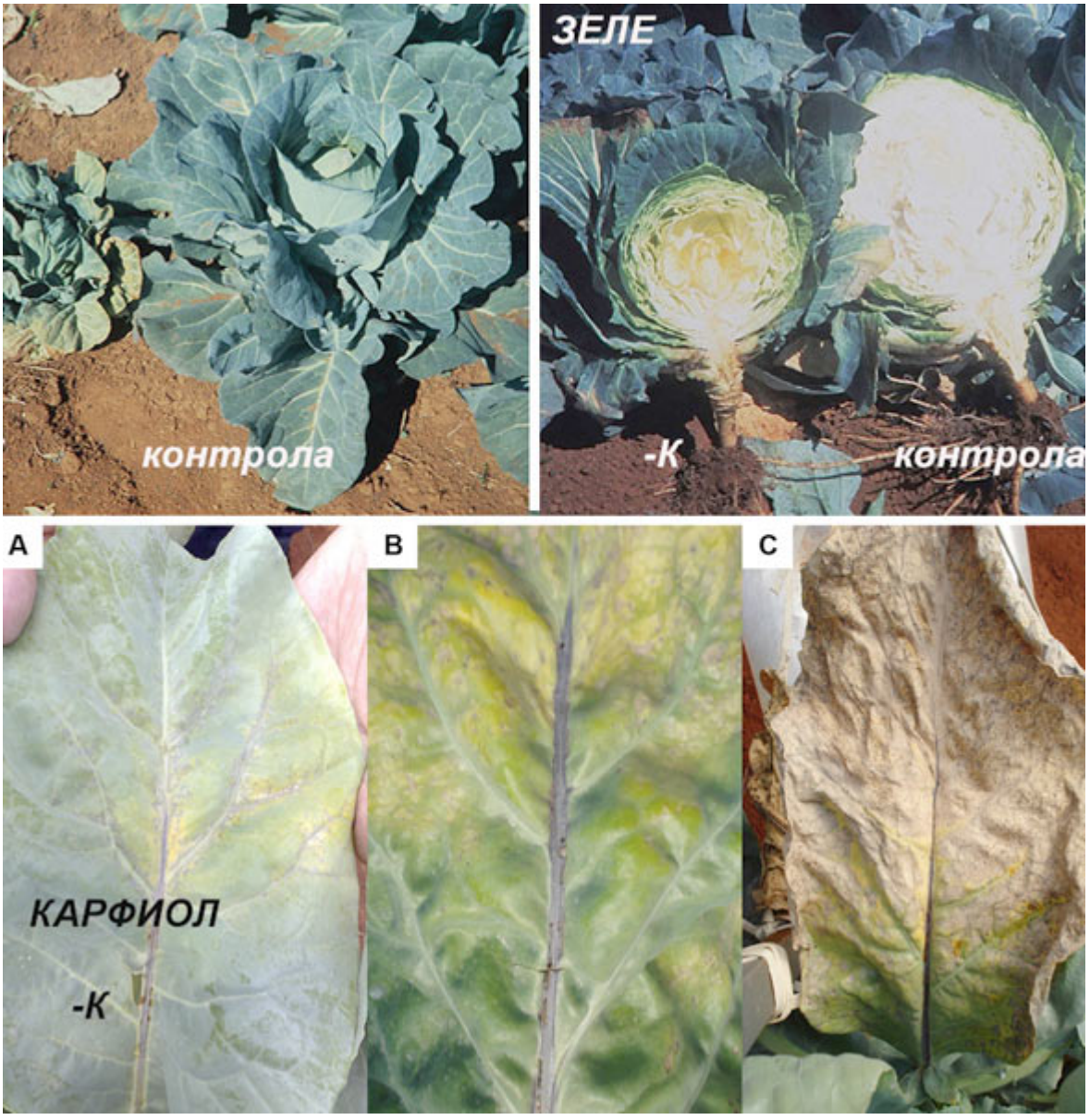
- Chlorosis appears on the lower leaves, which progresses to necrosis along their periphery and gradually affects the entire plant;

- The root system is smaller.



Potassium deficiency in leafy-stem vegetable crops. In cauliflower (below) development of symptoms: A = chlorosis and initial necrosis; B = advanced stage of vein necrosis; C = advanced necrosis

Symptoms of potassium deficiency in leafy-stem vegetable crops:

- Growth is retarded. Plant size is smaller;

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- Chlorosis begins along the edges of older leaves and progresses to necrosis. Necrosis affects the venation and the entire leaf;

- A smaller and looser head is formed;

- Yield is lower.

Potassium deficiency in bulb vegetable crops

Symptoms of potassium deficiency in bulb vegetable crops:

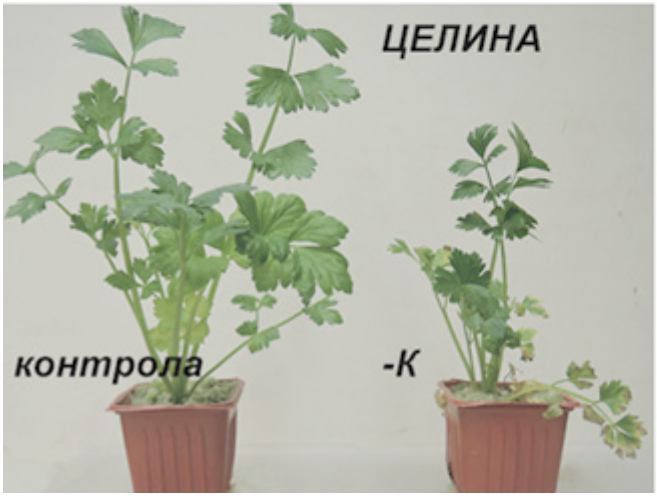
- Growth is weaker;

- Brown tips appear on older leaves. Gradually the leaves die off;

- Sugar content in the bulbs decreases;

- Bulb quality during storage is impaired;

- Yield decreases.



Potassium deficiency in root vegetable crops

Symptoms of potassium deficiency in root vegetable crops:

- The plant habit changes: plants are flaccid;

- In severe deficiency leaves turn yellow;

- Necrosis appears along the periphery of older leaves. They curl backwards and gradually die. Symptoms are similar to those of water stress or pest damage in spring.

- Product quality is impaired. Yield is low.

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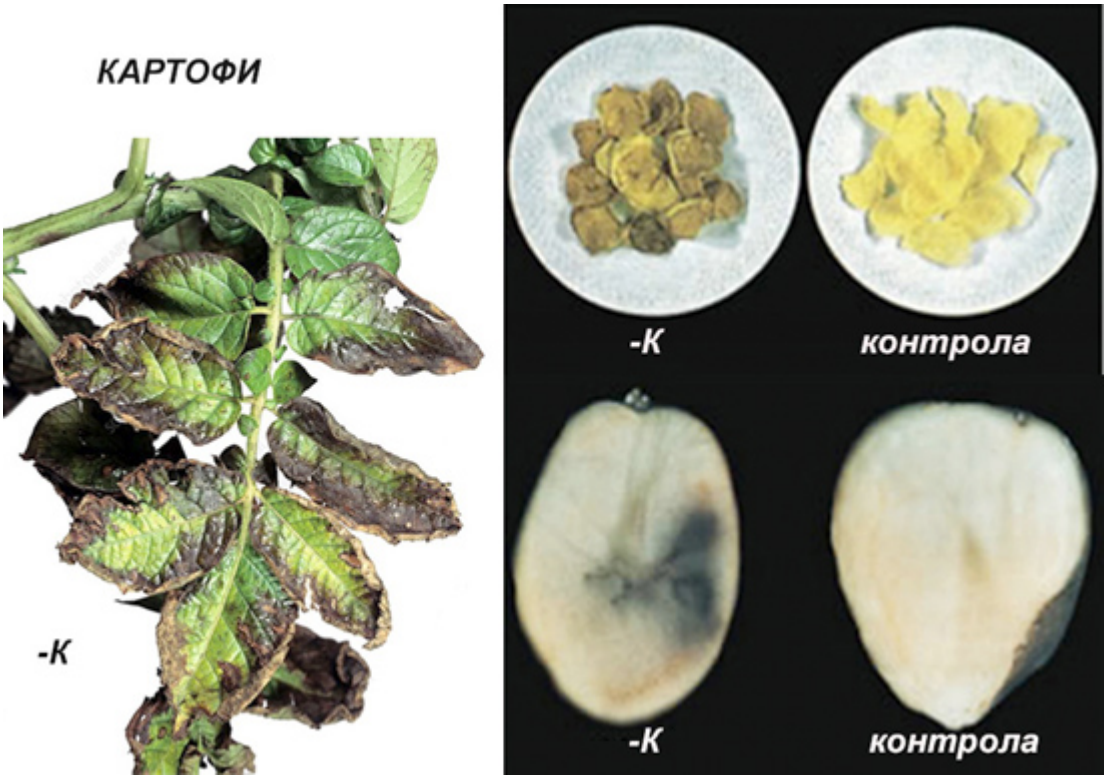

Potassium deficiency in tuber vegetable crops

Symptoms of potassium deficiency in tuber vegetable crops:

- Chlorosis on lower leaves accompanied by necrosis along their edges. Leaves die prematurely;

- Growth is slowed down;

- Tuber quality is impaired: internal black spots appear; frying colour is adversely affected; tuber size, mass and number are reduced; resistance to mechanical damage is reduced;

- Yield is low.

POTASSIUM EXCESS

General symptoms

In case of potassium excess, growth is delayed and root loss occurs. Internodes are elongated, leaves are light green. In later stages mosaic-like spots appear, followed by dull spots. Leaves wilt and fall.

High potassium levels may cause typical “burning” symptoms due to increased concentration of soluble salts. Uptake of calcium, magnesium and boron is impaired, so plants show symptoms of deficiency of these nutrients.

Product quality is impaired. In potatoes, the dry matter content of tubers decreases.

Cause

High potassium level in the nutrient medium. The effect is intensified at low nitrogen level in the medium.

Recommendation

With good drainage, leaching of the nutrient medium (soil, substrate). Foliar feeding with borax 0.2%. Application to the soil of MgO 2–3 kg/da. In hydroponic culture, irrigation with a solution containing 150 ppm Ca and 30 ppm Mg.

Identification of potassium excess symptoms by crop

Potassium excess in fruit vegetable crops

(potassium excess leads to magnesium deficiency)

Symptoms of potassium excess in fruit vegetable crops:

- Symptoms of calcium deficiency (blossom end rot of the fruit) and/or magnesium deficiency (interveinal chlorosis) appear;

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- Growth retardation.