

# CRITICAL ROLE OF CALCIUM IN CROP PRODUCTION

Calcium is an essential nutrient for crops, playing a vital role in their development and overall health. Its significance in plant physiology cannot be overstated, as it contributes to various critical functions necessary for plant growth and resilience. However, its immobility within plant tissues presents unique challenges, particularly in maintaining adequate calcium levels across all parts of the plant.

Calcium is a very immobile element within plant tissues. In the majority of plants, immobility means that once calcium is deposited in a particular part of the plant, it cannot be redistributed to other areas. As a result, calcium deficiency symptoms are most often observed in younger leaves, flowers, fruits and growing points, where the demand for calcium is high, but supply is limited.

The movement of calcium within a plant is largely dependent on transpiration pull. During periods of high transpiration, such as on sunny days, plants pull up more water from the soil to cool themselves. This process facilitates the uptake and transport of calcium from the roots to the upper parts of the plant. Conversely, during rainy seasons or high humidity conditions, transpiration rates are low, leading to reduced calcium uptake and an increased risk of deficiency.

Calcium deficiency can significantly impact crop health and yield. Understanding the signs and symptoms of calcium deficiency, as well as the consequences for crops, is vital for effective crop management and yields optimization

## Signs and symptoms of calcium deficiency

### a) Young leaf necrosis

Calcium is relatively immobile within the plant, so deficiencies often first appear in new growth where the calcium supply is inadequate. Calcium deficiency causes necrosis, or the death of tissue, which appears at the tips and margins of younger leaves.

### b) Stunted growth

Calcium is critical for cell division and elongation. Its deficiency restricts growth in both shoots and roots, leading to overall stunted growth with small, distorted leaves and poor root development.

### c) Blossom End Rot

Insufficient calcium during fruit development leads to this disorder, as calcium is crucial for cell wall integrity. This is physically shown by dark, sunken



spots on the blossom end of fruits, particularly common in tomatoes, peppers, and melons.

### d) Leaf tip burn

Rapid transpiration and inadequate calcium transport to leaf margins cause cell death and the browning of leaf tips. This is evidently shown by the burnt or scorched appearance of leaf



tips, especially in leafy vegetables like lettuce and cabbage.

### e) Internal rot

Calcium deficiency can cause the breakdown of internal plant tissues, leading to rot and decay from the inside. This is seen by the browning and rotting of internal tissues in crops such as carrots and lettuce.



## Strategies for Correcting Calcium Deficiency

Calcium plays crucial roles in multiple physiological processes, and its deficiency results in reduced yields, low quality produce, increased susceptibility to diseases and poor post-harvest quality. Calcium deficiency can be corrected through:

**Soil application:** Drenching calcium as a soil conditioner helps raise soil pH and supplies calcium to the soil. Cal 40 unique slow release mechanism enhances its availability at all times thus improving soil structure and providing a steady supply of calcium.

**Foliar application:** Provides calcium and helps improve plant health and enable the plants own defenses against pest and diseases. Cal 40 being a readily available source of calcium that can be applied directly to leaves, it quickly addresses deficiencies and strengthens plant structures.

## Cal 40; the best Calcium Product

Vicentia East Africa proudly presents Cal 40, a premium calcium nutrition product hailed as the king of all elements. With a remarkable 56% Calcium Oxide content and 40% calcium elemental, Cal 40 stands out for its superior formulation and myriad benefits for enhancing crop health and productivity. Cal 40 is the most concentrated source of calcium available for agricultural production. This high concentration ensures that plants receive an ample supply of this essential nutrient. This formulation is designed to maximize the bioavailability of calcium enhanced by its slow-release mechanism making it more readily available for absorption at all times for efficient utilization and minimizing wastage. The Cal 40 particles are so fine ( $\geq 2\mu\text{m}$ ) that 1ml of Cal 40 has a surface area of 4.5 M2. Cal 40 does not contribute to the EC in the solution (when mixed in a fertigation tank) or in the soil as it's a suspension concentrate formula (SC). Less EC means less salinity stress on the roots.

## The importance of calcium in crop production

### Nutrient absorption and translocation within the plant.

Calcium is essential for root growth and development. It helps in the formation of root hairs, which increase the surface area for water and nutrient absorption from the soil. Healthy root systems are crucial for the efficient uptake of nutrients. Calcium also aids in the uptake of other nutrients by improving soil structure. It reduces soil acidity and promotes the availability of other essential nutrients like potassium and magnesium.

Calcium plays a significant role in the function of the plant's vascular system, particularly in the xylem and phloem. It helps in the movement of water and dissolved nutrients from the roots to other parts of the plant through the xylem.

The movement of calcium within the plant is closely linked to the transpiration stream. During periods of high transpiration, calcium is transported more effectively from the roots to the shoots and leaves.

### Role of calcium in enzyme action

Calcium activates several important enzymes, which are involved in numerous cellular processes. The calcium-binding proteins regulate various functions, such as nutrient uptake and hormone signaling, essential for the plant's growth and development.

Calcium acts as a cofactor for several enzymes involved in the nitrogen metabolism pathway. One of the key enzymes in this pathway is nitrate reductase, which is responsible for the reduction of nitrate to nitrite, an essential step in the assimilation of nitrogen into organic forms. Calcium contributes significantly to the conversion of nitrogen into amino acids and proteins which requires enzymes. Calcium ions ( $\text{Ca}^{2+}$ ) are necessary for the proper functioning of these enzymes, ensuring efficient nitrogen assimilation and protein synthesis for vigorous foliage which translates into improved growth.

### Plant Structural Integrity

Calcium is crucial for the production of plant tissue. It is a fundamental component of plant cell walls and membranes, contributing to stronger cellular structures. This structural role is critical for maintaining the cellular environment necessary for the optimal function of metabolic processes, including nitrogen assimilation and protein formation. The presence of calcium fortifies cell walls, making them robust and capable of withstanding physical stresses.

### Enhancing the crops' defense mechanisms

Calcium is a vital nutrient for plants, playing a critical role in their defense mechanisms against various biotic and abiotic stresses. Its importance extends beyond its structural functions in cell walls and membranes to its involvement in signaling pathways and stress responses.

Calcium ions ( $\text{Ca}^{2+}$ ) act as secondary messengers in cellular signaling pathways. When a plant is under attack by pathogens or exposed to stress, calcium signals are rapidly generated and transmitted within the cell. These signals activate various defense-related genes and proteins. Calcium signaling triggers the activation of specific genes involved in the plant's immune response. This includes the production of defensive proteins, such as pathogenesis-related proteins, which help in fighting off infection.

Strong cell walls, facilitated by calcium, act as barriers against pathogens. Healthy plants with adequate calcium are less likely to suffer from diseases that could impair their ability to assimilate nitrogen and produce proteins for optimal growth.

Calcium helps plants manage abiotic stresses like drought and salinity. By maintaining cell wall integrity and

regulating the osmotic balance, calcium ensures that metabolic processes, including nitrogen assimilation, continue efficiently even under stress conditions.

### Enhanced growth, development and yield increase

Calcium is an essential macronutrient that plays a pivotal role in the growth, development, and overall productivity of crops. Its importance cannot be overstated, as it contributes to a variety of physiological and biochemical processes that are crucial for healthy plant development and optimal yields.

Calcium is crucial for the development of fruits and seeds. It ensures proper cell division and expansion, leading to well-formed and high-quality produce. Adequate calcium levels prevent common disorders such as blossom end rot in tomatoes and bitter pit in apples.

By supporting overall plant health and resilience, calcium contributes to increased crop yields. Healthy plants with strong structural integrity and efficient nutrient metabolism are more productive and capable of achieving higher yields, which is the ultimate goal of every grower by ultimately having a great impact on returns.

### Enhancing post-harvest quality and Pro-longed shelf-life

Calcium is a crucial nutrient for plants, and its significance extends beyond growth and development to the post-harvest quality and shelf life of produce. Adequate calcium levels in crops significantly improves the durability, appearance, and marketability of fruits and vegetables by enhancing their structural integrity and resistance to post-harvest deterioration.

Calcium is also a crucial element that plays a significant role in enhancing the shelf life of rose petals. Its effects on cell wall structure, membrane stability, and metabolic processes collectively contribute to the longevity and quality of rose petals during storage and display.

### Conclusion

For growers aiming to maximize their crop production and profitability, the importance of calcium cannot be overstated. Ensuring an adequate supply of calcium through effective fertilization practices is key to achieving higher yields, better quality produce, and ultimately, higher income. By investing in calcium nutrition, farmers can enhance the health and productivity of their crops, securing a more prosperous and sustainable future in agriculture.

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