

Tip burn in Lettuce: Calcium or Potassium Deficiency?

In practice, tip burn in leafy crops is mostly seen as a result of calcium deficiency. However, NovaCropControl came to a different conclusion through nutrient research. While calcium deficiency can be a cause, in most cases, it is potassium deficiency that is the main issue.

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In 2024, Roy Keunen from NovaCropControl conducted research on the possible causes of tip burn in leafy crops. The study was carried out on Romaine lettuce because this variety is particularly sensitive to tip burn during the head formation phase. This refers to dry tip burn, not wet tip burn caused by excessively high root pressure. Keunen carried out three trials, each planted consecutively in a large poly greenhouse research facility on gutters with stone wool as the substrate. This approach makes it easier to establish correlations compared to field trials. The results are fully applicable to outdoor situations, although in the field, additional factors such as soil properties and nutrient balance influence nutrient availability.

Adjusting the K/Ca Ratio

In his first study, Keunen tested varied K/Ca ratios. A standard nutrient solution contains 5.8 mmol/l of potassium and 5.8 mmol/l of calcium. In the 'high K/Ca' treatment, Keunen increased the potassium amount to 8.5 mmol/l while reducing calcium to 4.3 mmol/l. In the 'low K/Ca' treatment, he reduced potassium to 3.6 mmol/l and increased

calcium to 6.8 mmol/l. Other treatments included adding boron or silicon, as well as boron plus silicon, to the 'high K/Ca' group. He also varied the Mg/Ca ratio and the EC level. Additionally, a treatment with sodium was included. In total, eleven treatments were tested, with three repetitions each.

Follow-up Research

Based on the results from the first trial, a second study was conducted, including treatments with extremely high and low K/Ca ratios. In the extremely low treatment, 1.7 mmol/l of potassium and 7.8 mmol/l of calcium were applied, while in the extremely high treatment, 12.3 mmol/l of potassium and 2.5 mmol/l of calcium were used. The treatments in the third trial focused on

adjusting fertilization schedules during the cultivation period. The findings from the first two studies were used to fine-tune potassium levels based on plant sap analyses, such as switching from 'low K/Ca' to 'extremely high' and from 'high K/Ca' to 'extremely high.' Keunen concludes from the results of the three successive studies that a clear pattern emerges: "It is clear that high potassium levels reduce the occurrence of tip burn, and this is further minimized with extremely high potassium doses. Additionally, adding silicon further reduces tip burn in older leaves."

Nutrient Uptake

Keunen did not only look at the effect on tip burn but also examined the nutrient uptake by plants in the different treatments. It was found that with higher potassium doses, the plants absorbed more potassium, while the calcium uptake remained about the same. "Despite the equal uptake of calcium, reduced potassium



Tip burn in lettuce. Picture: NovaCropControl



The choice of the method for additional fertilization depends on the crop stage and the amount of time the plant has left to absorb nutrients.

application and uptake resulted in more tip burn. This proves that the tip burn is due to potassium deficiency, not calcium deficiency." The addition of silicon made the cell walls slightly stronger, thus providing better resistance to the development of tip burn.

Tip Burn Symptoms

Regarding tip burn on younger leaves, the treatments 'extremely high' and 'high' with added silicon showed the best results. The treatment 'high' without silicon showed slightly more tip burn. In all other treatments, more tip burn appeared on the younger leaves.

The same trend was observed on older leaves. Interestingly, the addition of silicon to the standard scheme also resulted in very little tip burn on older leaves, even less than in the 'high' treatment. Only in the 'high' plus silicon treatment was tip burn even less frequent on the older leaves.

Yields

From the evaluation of the average head weight in the second trial, it was clear that the 'low' and 'extremely low' treatments showed lower yields.

There was a 280-gram difference between the 'extremely low' and 'extremely high' treatments. Therefore, the 'extremely low' treatment was excluded from the third trial. The conclusion from this treatment is that with even lower potassium uptake, tip burn persists, and head weight decreases.

In the third trial, the 'low' treatment also produced the lowest average head weight. The average head weights were not significantly different, but the treatment that started with a 'high' nutrition schedule and then switched to 'extremely high' resulted in the highest average head weight. Potassium levels were found to affect head weight. In all three trials, the 'high' and 'extremely high' treatments achieved the highest head weights.

Practical Implications

To prevent tip burn, NovaCropControl's research results can be applied to substrate/water-based crops by using appropriate start schedules with potassium supplementation during the growing season. In field cultivation, the situation is more complex. Keunen advises conducting a soil balance analysis before starting a crop.

This analysis reveals the levels of main and trace elements in the soil. It also provides insight into other parameters such as pH, EC, and organic matter content. "This way, you know the availability and ratio of various nutrients in the soil." In the soil, the ideal ratio between calcium, magnesium, and potassium is 68%, 12%, and 5%, respectively. The closer the values are to these target levels, the easier it is for plants to absorb the nutrients. Particularly in soil, not all nutrients present are available to plants. This depends on several factors. "The amount available to the plant can be measured by taking a soil extract. Additionally, we perform plant sap analyses throughout the season to ensure adequate uptake. Based on this, we provide advice to adjust nutrient levels during the cultivation. This can be done by top-dressing, typically performed with main elements, or through foliar application, typically performed with trace elements. The choice of method depends on the crop stage and whether the plant has enough time to absorb the nutrients before harvest."