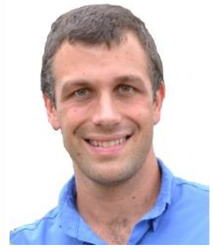
e-GRO Edible Alert

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Inner leaf “tip-burn” in lettuce

Not all nutritional problems are caused by supplying too much or too little of a certain nutrient. “Tip-burn” of inner leaves is a common problem in hydroponic lettuce, where the margins of the young emerging leaves develop necrosis and burn as shown in Figure 1. The necrosis is from a calcium deficiency, but the actual problem is more the result of poor environmental conditions and water uptake. The lettuce in Figure 1 received an adequate supply of all plant essential nutrients in the hydroponic nutrient solution.

This e-GRO Edibles Alert article covers the cause of inner leaf tip-burn, how to differentiate tip-burn from other forms of marginal leaf necrosis, and best management practices to prevent inner leaf tip-burn during hydroponic production.

Figure 1. Inner leaf tip-burn on lettuce appears as necrosis along leaf margins at the center of the head. Photo courtesy of Iowa State University, Ajay Nair (https://bit.ly/2FtiPI1)

Inner leaf tip-burn is a physiological disorder involving calcium and water uptake

Calcium moves through plants passively and is carried with the flow of water. As plants transpire and take up water, calcium is essentially "pulled" up from the roots and throughout the plant. Rapid transpiration promotes calcium uptake and distribution within the plant. On the other hand, low transpiration rates decrease calcium uptake and transport.

The growing tip of lettuce is enclosed by leaves that make up the lettuce "head," which block air movement and create a very humid micro-environment around the growing tip. This humid micro-environment results in low transpiration of the growing tip and reduces calcium transport to the new leaves, even if the outer leaves are transpiring adequately. With low transpiration to the growing tip, insufficient transport of calcium causes the tissue along the young leaf tips to collapse and turn necrotic as the leaves expand.

In this scenario, the problem is not insufficient calcium supplied to the root zone, but a physiological disorder related to poor transpiration of water and humid environmental conditions.

A similar type of physiological disorder occurs with fruiting crops such as tomato, cucumber, pepper, and eggplant, but is called "blossom end rot." Fruits have relatively low transpiration rates, and under rapid fruit growth and swelling, localized calcium deficiency occurs at the base of the fruit. The collapsed plant tissue also turns necrotic and resembles rotting as show in Figure 2.

Figure 2. "Blossom end rot" related to calcium deficiency in tomato. Sonneveld, C. and W. Voogt. 2009. Plant nutrition for greenhouse crops. Springer. The Netherlands.

Figure 3. Horizontal airflow fans increase lateral air movement over crops. (https://bit.ly/2OfntvZ)

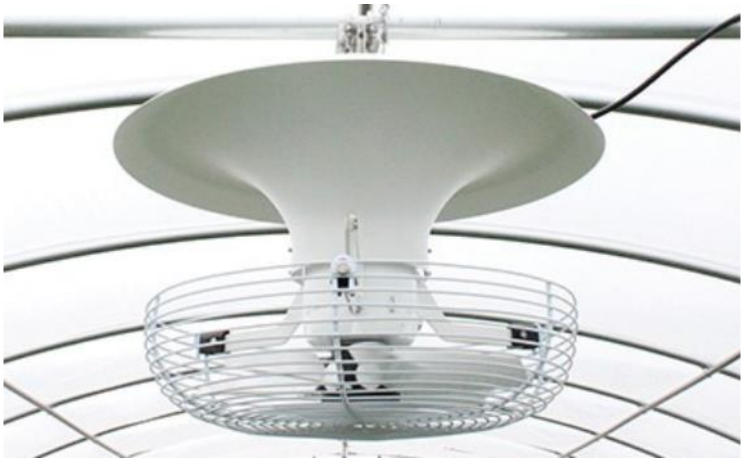

Figure 4. Vertical airflow fans force air movement directly down to the crop. (https://bit.ly/2To5vrU)

Drought stress, high soluble salts, and chemical phytotoxicity can also cause leaf tip-burn in lettuce and other leafy greens. However, symptoms of these problems tend to occur on older and mature leaves, whereas inner leaf tip-burn from poor transpiration and calcium transport occurs in young expanding leaves within the head.

Avoiding inner leaf "tip-burn" in lettuce

Unfortunately, there is no way to salvage necrotic leaf tissue. But there are strategies growers can use to facilitate calcium uptake and prevent inner leaf tip-burn.

Fertilize with adequate amounts of calcium. First check that adequate calcium is supplied in the nutrient program. Supplying 40-50ppm of calcium in the applied fertilizer or hydroponic nutrient solution is a good starting point. Depending on the source, the raw irrigation water may also contain calcium. Increasing calcium in the nutrient solution can help with calcium uptake and reduce inner leaf tip-burn problems, but remember the real problem is more often related to environmental conditions that affect water transpiration.

Calcium foliar sprays. Weekly foliar sprays with calcium solution is a strategy to increase calcium concentrations directly in plant tissues. A starting rate is 400ppm calcium mixed using calcium chloride fertilizer salts (not calcium nitrate). Always trial on a few plants before the whole crop. This strategy can be labor intensive and may leave residues on leaf surfaces, and is not often used in commercial practice for lettuce.

Modify the growing climate. Low relative humidity and air movement increase plant transpiration and facilitate calcium uptake. Consider manipulating the greenhouse heating and venting systems to dehumidify the air during cool and cloudy weather. Increase use of horizontal and vertical airflow fans to improve air movement (Figures 3 and 4). Conditions that promote rapid plant growth and leaf expansion promote inner leaf tip-burn, and shading/cooling under excessively high light and temperature conditions can help minimize risk.

Avoid antagonistic effects from other fertilizer nutrients. High concentrations of ammonium nitrogen, potassium, and magnesium in the nutrient solution can block calcium uptake by roots. Tips to prevent nutrient antagonisms include limiting ammonium to 15% of total supplied nitrogen and maintaining the ratio of calcium:potassium at approximately 1:2 and the ratio of calcium:magnesium at approximately 2:1 in the applied nutrient solution.

Avoid high soluble salts. High soluble salts reduce the ability for plants to take up water and calcium. If possible, maintain root zone electrical conductivity below 2.0 mS/cm.

Select resistant varieties. Work with your seed supplier to select varieties specifically bred for lower susceptibility to inner leaf tip-burn.

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