e-GRO Edible Alert


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Lettuce tipburn sensitivity trial – Preliminary results

This e-GRO Alert reports our most recent trial testing 20 selected cultivars of lettuce grown under controlled environment to find their sensitivity to tipburn.

Tipburn is caused by calcium deficiency often seen in lettuce (*Lactuca sativa*) when plants are grown quickly under optimum environmental conditions. The deficiency is also known as "localized" around young leaves at the shoot tip. Therefore, tipburn occurs even with sufficient calcium fertilization of the whole plant. While the symptom is well described and mitigation methods are discussed (e.g., Mattson, 2015; Kubota et al., 2023), cultivar-specific tipburn sensitivity is not well documented. Specifically, comparisons among various cultivars supplied by different seed companies under growth conditions inducing tipburn are helpful for growers.

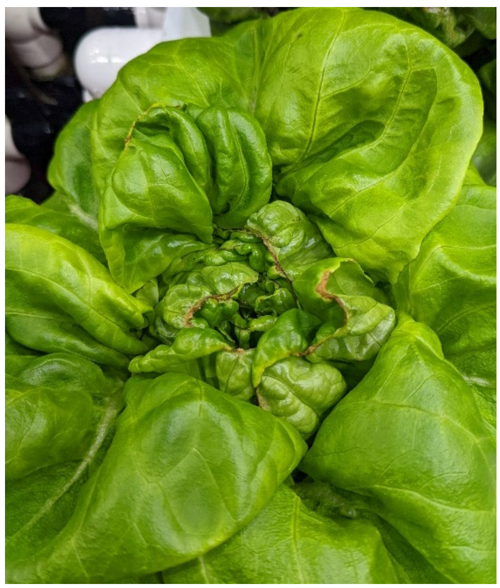
Figure 1. Severe tipbrun symptom shown in 'Rex' lettuce at the time of harvest. Photo by J. Ertle

Tipburn-inducing plant growth conditions:

Previous research conducted by many groups have contributed to better understanding which environmental factors induce tipburn in lettuce. In general, conditions that promote overall plant growth (high light, high CO_2) yet suppress plant transpiration rate (low air circulation, high humidity) are known to increase the risk of tipburn. In addition, low humidity (high VPD) during nighttime increases tipburn risk in some cases. This is because low humidity at night promotes non-stomatal transpiration (loss of water from leaf surface), reducing xylem pressure and calcium supply to the shoot tip at night (Kubota et al., 2023). Table 1 shows the conditions we selected for testing tipburn sensitivities of 20 selected cultivars of lettuce (Table 2). Seedlings were grown for 14 days prior to transplanting into hydroponic nutrient film technique (NFT) channels to assess the tipburn sensitivity for the following 28 days.

Table 1. Tipburn-inducing plant growing conditions used in the present trial.

Environmental conditions (set points)	Growing systems and other conditions
Air temperatures (day/night): 23/19°C (73/66°F) **Humidity (day/night):** 75/60% RH (0.70/0.88 kPa VPD) **PPFD:** 290 μmol m^{-2} s^{-1} **DLI:** 17 mol m^{-2} d^{-1} **Photoperiod:** 16 h d^{-1} **Light source:** LEDs (19% blue, 10% green, 71% red) **CO_2 concentration**: 1,000 ppm (daytime) **Air circulation:** <0.1 m s^{-1} horizontally and vertically	**Growing system:** a walk-in growth chamber (9 m^2) **Hydroponic system:** NFT **Nutrient solution:** A leafy green formula containing 166 NO_3-N, 37 P, 157 K, 28 Mg, 186 Ca in addition to other key elements. **Substrate for seedlings:** rockwool **Planting density:** 34 plants m^{-2}

Table 2. Twenty cultivars used for assessing tipburn sensitivity.

Cultivar name	Type	Leaf color	Seed supplier
Azirka	Crispy	Red	Enza Zaden
Breen	Mini Romaine	Red	Johnny's Selected Seeds
Coconino	Salanova	Red	Rijk Zwaan
Cospenza	Cosberg (romaine x iceberg)	Green	Enza Zaden
Crispinet	Crispy	Green	Enza Zaden
Dragoon	Romaine	Green	Johnny's Selected Seeds
Euler	Salanova	Green	Rijk Zwaan
Green Forest	Romaine	Green	Johnny's Selected Seeds
Klee	Leafy	Red	Rijk Zwaan
Lalique	Crystal	Green	Rijk Zwaan
Limambo	Burger leaf	Green	Rijk Zwaan
Litska	Lolla Rossa	Red	Enza Zaden
Monte Carlo	Romaine	Green	Johnny's Selected Seeds
Newham	Little Gem	Green	Johnny's Selected Seeds
Rabello	Romaine	Green	Rijk Zwaan
Rex	Butterhead	Green	Rijk Zwaan
Rosalyn	Oak leaf	Red	Enza Zaden
Rouxai	Oak leaf	Red	Rijk Zwaan
Tropicana	Leafy	Green	Enza Zaden
Veery	Batavia	Red	Enza Zaden

Tipburn rating methods:

Various methods are used to diagnose tipburn symptoms by different research groups. We used the following two variables, following the work done by Ertle (2023). Namely, 1) time to tipburn emergence (days) and 2) tipburn severity (%, number of leaves showing tipburn symptom over the total number of leaves (>1 cm^2) per plant at the time of harvest).

Preliminary trial results:

All cultivars except 'Rabello' (green romaine) and 'Rouxai' (red oak leaf) exhibited tipburn symptom between 16 and 24 days after transplanting (30 and 38 days after seeding) (Figure 2A). When harvested 28 days after transplanting, 'Rouxai' plants had a small number of hidden inner leaves exhibiting tipburn. This means that 'Rouxai' will develop visible tipburn symptomology within a few days for a crop cycle longer than 28 days (38 days after seeding) under this growing condition. Similarly, the days to tipburn emergence of 'Azirka', 'Coconino', 'Euler', 'Lalique', 'Limambo', 'Tropicana', and 'Veery' were 21 days or longer. This means that these cultivars can be grown for a shorter cycle production (e.g., 21 days after transplanting) without having visible tipburn symptoms. Our environmental conditions are highly-tipburn inducing, and therefore, selecting tipburn preventative conditions (such as high vertical air circulation) should be able to slow down or eliminate the development of tipburn symptoms for all cultivars.

When assessed 28 days after transplanting, tipburn severity of 20 cultivars ranged between 0 and 58 % of all leaves (Figure 2B). 'Rabello' (green romaine) had no leaves showing tipburn symptom and was considered as the most tolerant cultivar among those we tested under this tipburn-inducing environmental condition. In contrast, 'Dragoon' (green romaine) was the most tipburn-sensitive, having the shortest time to tipburn emergence and second-highest tipburn severity. Tipburn severity was found highly correlated with days to tipburn emergence. Namely, cultivars exhibiting tipburn early tended to have higher severity at the time of harvest. In contrast, yield (head fresh mass, Figure 2C) was not correlated with any tipburn ratings, suggesting that high-yielding trait is not associating with tipburn sensitivity. This trial showed that tipburn sensitivity cannot be associated with types of lettuce, color, or yield. As our trial condition was highly tipburn-inducing, growers are recommended to conduct their own testing in their growing conditions. We are currently conducting further analyses and the results will be reported as they become available.

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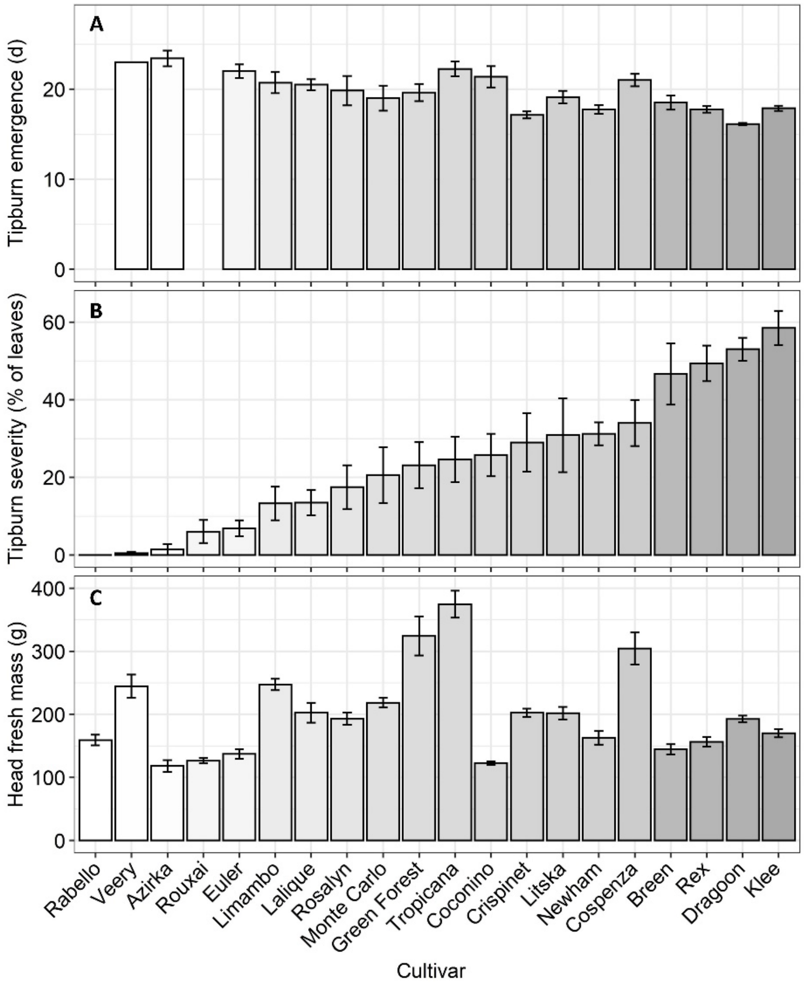

Figure 2. Days to tipburn emergence (A), severity (B) and head fresh mass (g) of twenty lettuce cultivars under a tipburn-inducing plant growth condition. Means ± S.E. (n=8)(Ertle, unpublished data).

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