OptimIA

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Tipburn Basics

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1

Topics

- Tipburn
  - Plant physiology
  - Nutrient transport
- Managing tipburn
  - Current and recommended practices

2

Ca^{2+} deficiencies in plants

- Blossom end rot of tomato
- Tipburn
  - In hydroponics, usually caused by the **environment**

Blossom end rot of tomato

Rebecca Finneran, MSU Extension

Tipburn of strawberry leaves and calyx

https://u.osu.edu/indoorberry/tip-burn/

Tipburn of lettuce

Dr. Chieri Kubota, OSU

3

Tipburn ≠ Edge-burn

- Tipburn is a **calcium deficiency** (seen on leaf margins)
- Edge-burn is **salt accumulation** (seen on leaf margins)

Tipburn

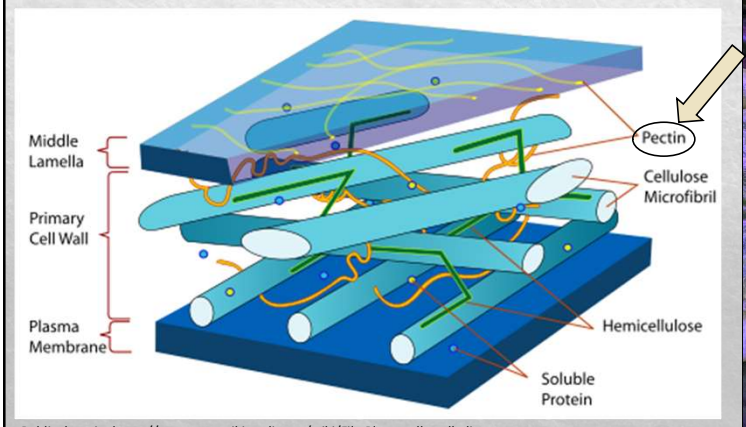
Edge-burn

N. Mattson (2015, e-GRO) - https://www.e-gro.org/pdf/2015_431.pdf

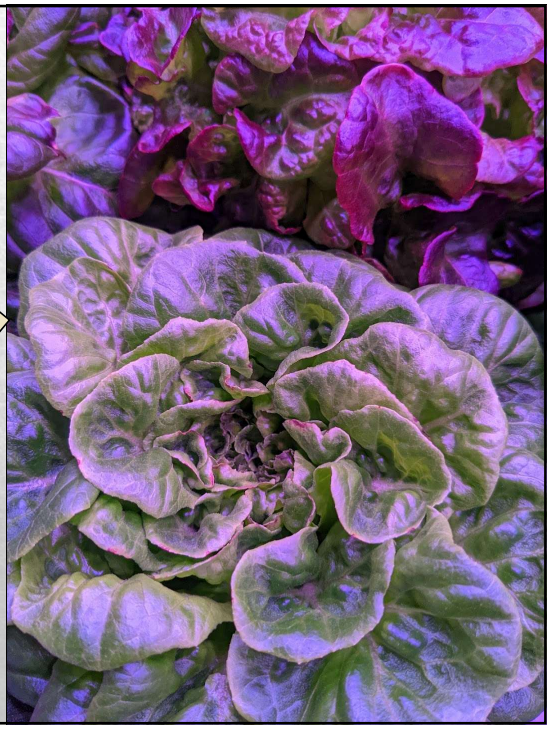
4

Lettuce tipburn

- Necrotic tissue formation
  - On leaf margins or growing shoot tip
- Caused by Calcium (Ca^{2+}) deficiency



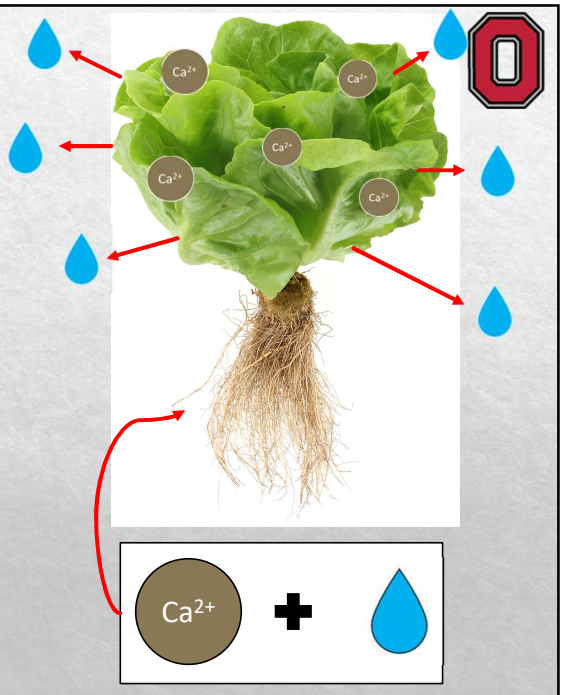
Public domain: https://commons.wikimedia.org/wiki/File:Plant_cell_wall_diagram-en.svg



5

Calcium (Ca^{2+}) uptake

- Calcium is a **cation**
  - Uptake reduced at low pH
  - Competes with other cations (e.g., Mg^{2+}, K^{+})
- Uptake driven by **mass-flow**
  - Daytime mass flow: Driven by **transpiration**
  - Nighttime mass flow: Driven by **root pressure**
- Transport via the **xylem**, not the phloem
- **Immobile**
  - Deficiency appears in young leaves

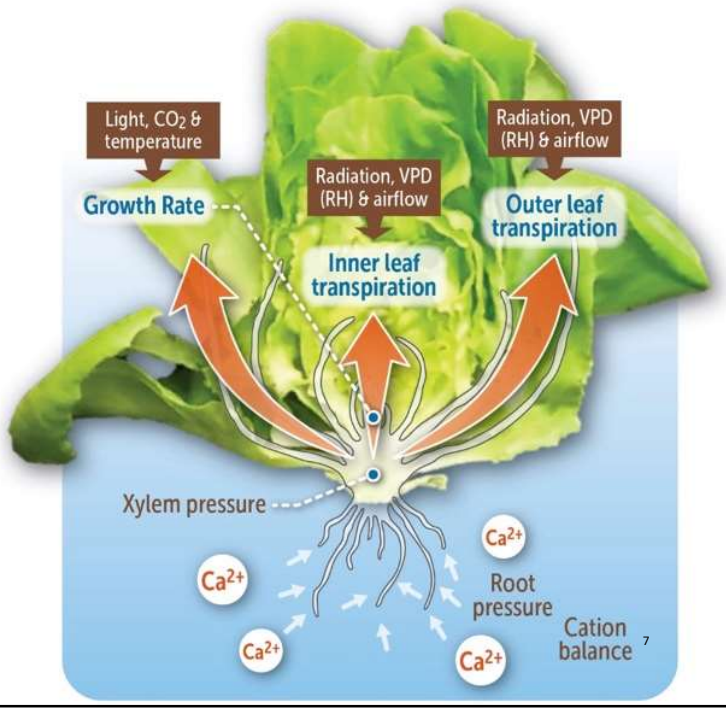


6

Ca^{2+} supply < demand

Supply
- Transpiration
- Root pressure

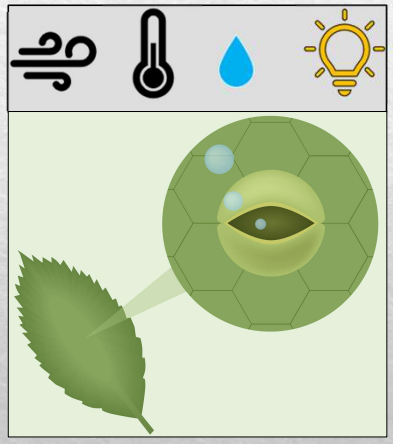
Demand
- Growth



7

Plant transpiration

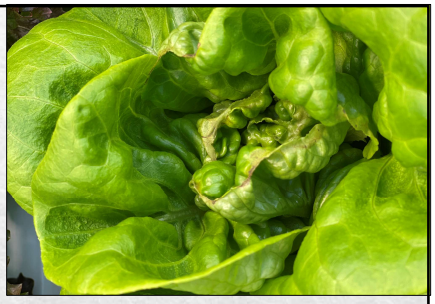
- Evaporation from plant tissue
- Rate of transpiration regulated by stomatal opening
- Transpiration influenced by:
  - **Wind**: more air flow = more transpiration
  - **Humidity (VPD):** more water in air = less transpiration
  - **Air and leaf temperature**: higher temperature = more transpiration
  - **Radiation**: more light = more transpiration
    - Sunlight (300 – 3000 nm) drives more transpiration than electric lighting (~400 – 750 nm)



8

Tipburn prevention

Dr. Chieri Kubota



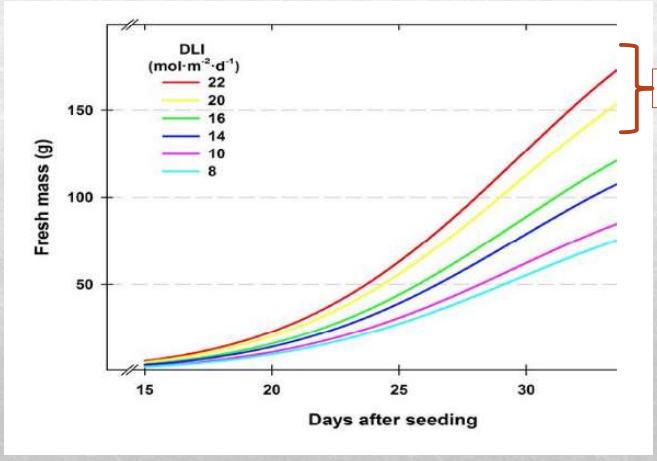
1. **Avoid** tipburn-sensitive cultivars
2. **Enhance** transpiration (mass flow)
   - Increase wind speed (to 0.3 – 0.5 m/s), reduce daytime humidity, increase nighttime humidity (to >95%)
3. **Harvest** early
   - Before tipburn develops around ~30-35 days after seeding
4. **Slow** down the plant growth
   - Limiting light (daily light integral; *DLI*)
   - Lowering temperature
5. **Spray** foliar Ca^{2+} (not recommended for indoor farm)
   - 400 – 800 ppm $CaCl_2$ 2-3x/week (may reduce plant growth)

9

Slowing the growth

Three methods:

1. **Limit the DLI**
2. Lower daytime temperature
3. Harvest early with increased planting density



Butterhead lettuce 'Ostinata' fresh weight under different DLI (daily light integral) (Original data by Both et al., 1997; chart published by Currey et al. 2017)

10

Slowing the growth

Three methods:

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2. **Lower daytime temperature**
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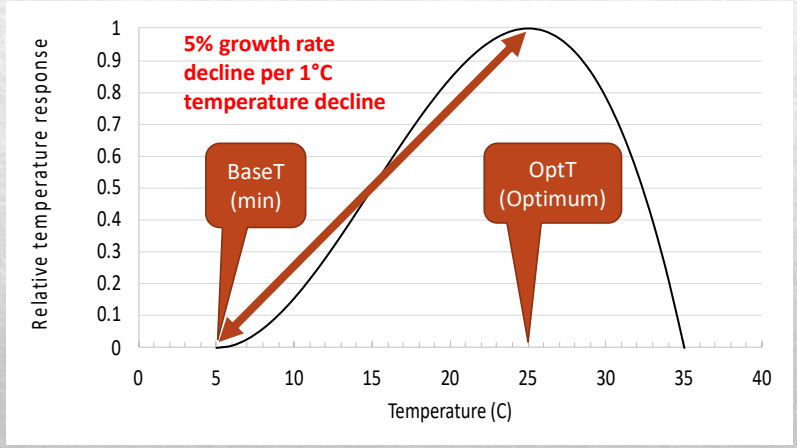

Temperature response curve (example) for crop growth

11

Slowing the growth

Three methods:

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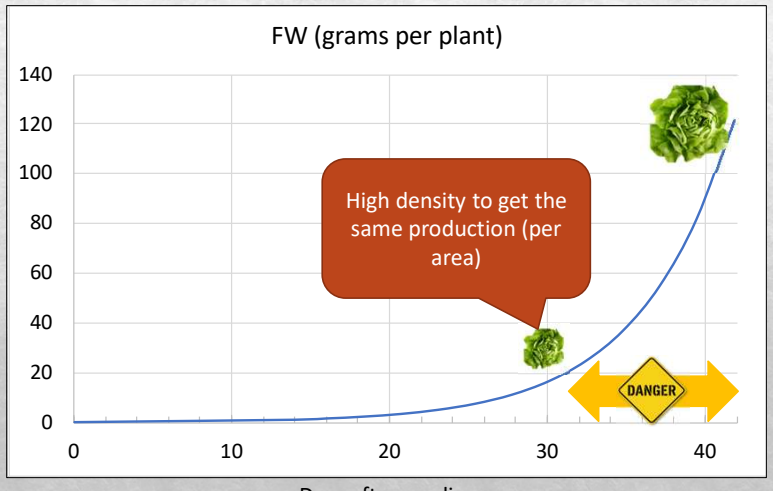

Courtesy of: Murat Kacira, KC Shasteen, Simone Valle de Souza, Chieri Kubota

12

Enhancing transpiration

- Addition of downward vertical air flow fans
  - Target: 0.3 – 0.5 m/s
  - Downward air enhances transpiration near the meristem

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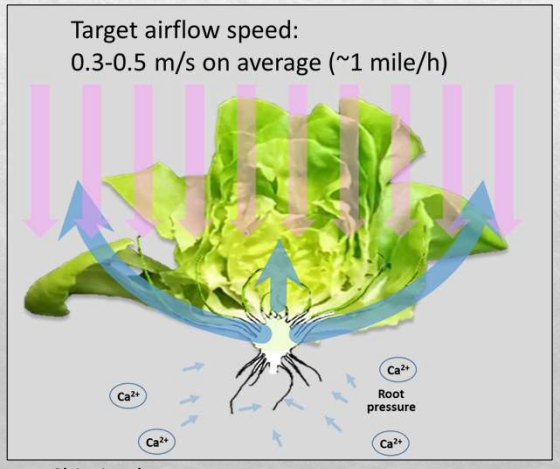

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13

Recommended reading

- Collier, G. F., & Tibbitts, T. W. (2011). **Tipburn of Lettuce**. *Horticultural Reviews*, *October*, 49–65. https://doi.org/10.1002/9781118060773.ch2
- Goto, E., & Takakura, T. (1992). **Prevention of lettuce tipburn by supplying air to inner leaves**. *Transactions of the ASABE*. https://doi.org/10.13031/2013.28644
- Goto, E., & Takakura, T. (2003). **Reduction of Lettuce Tipburn by Shortening Day/night Cycle**. *Journal of Agricultural Meteorology*, *59*(3), 219–225.
- Samarakoon, U., Palmer, J., Ling, P., & Altland, J. (2020). **Effects of Electrical Conductivity, pH, and Foliar Application of Calcium Chloride on Yield and Tipburn of Lactuca sativa Grown Using the Nutrient – Film Technique**. *HortScience*, *55*(8), 1265–1271. https://doi.org/10.21273/HORTSCI15070-20
- Vanhassel, P., Bleyaert, P., van Lommel, J., Vandevelde, I., Crappé, S., van Hese, N., Hanssens, J., Steppe, K., & van Labeke, M. C. (2015). **Rise of nightly air humidity as a measure for tipburn prevention in hydroponic cultivation of butterhead lettuce**. *Acta Horticulturae*, *1107*(January), 195–201. https://doi.org/10.17660/ActaHortic.2015.1107.26

14

Thank you!

Please contact John Ertle (Ertle.6@osu.edu) with any questions, comments, or suggestions!

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15