



Plant responses to environmental conditions: Air circulation

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Wind (Air Circulation)



- Air circulation (and its speed) is an important factor affecting positively and negatively the plant growth.
- Air current speed specifically affects gas exchange through boundary layer.
 - CO₂/O₂ (photosynthesis)
 - H₂O (transpiration)
- Air current speed affects plant temperature.

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Outdoor wind profiles

- Mean wind speed decreases as it gets closer to the surface (crop and soil).
- Wind speed is zero at the soil surface.
- Wind speed is constant at height away from the surface.

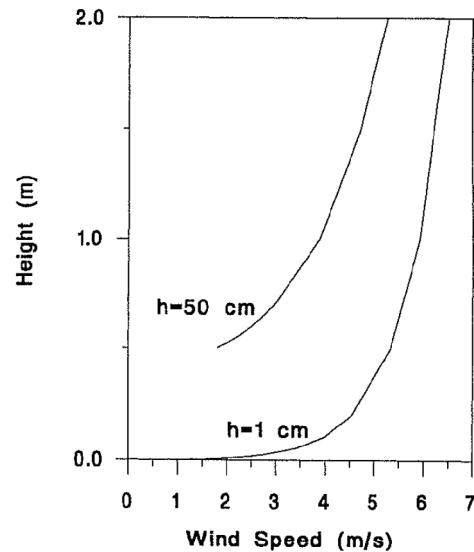


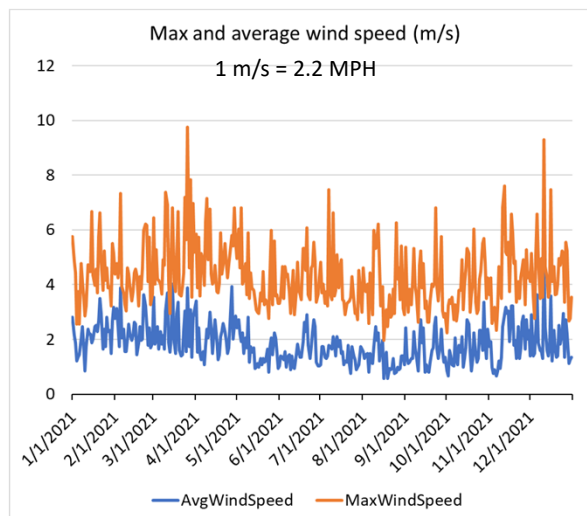
Figure. Profiles of wind speed above a 50 cm tall crop and a soil surface (1 cm above, without crops)

(Campbell and Norman, 1998)

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Example ranges of wind speed outdoors Columbus (OH): 1.0-4.0 m/s average

1 m/s = ~2 mile/h



OARDC Columbus data (2021)

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Air current speeds in greenhouses

Circulation fans (for temperature uniformity)

Greenhouse air current speed:

1.0 m s⁻¹ or less.

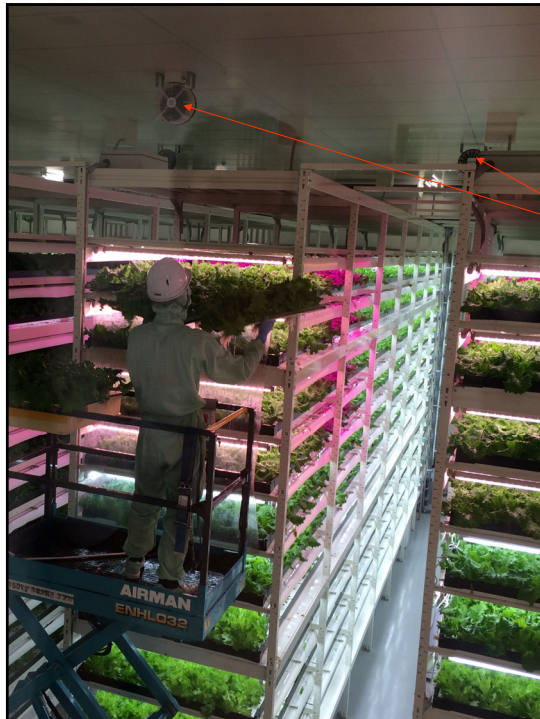
Under natural ventilation (without fans)

0.2 m s⁻¹ or less

Under forced ventilation (with fans)

0.2 – 1.0 m s⁻¹

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Air current speeds in indoor farms

Circulation fans (for temperature uniformity)

Indoor farm air current speed:

0.5 m s⁻¹ or less.

Without fans in crop head space

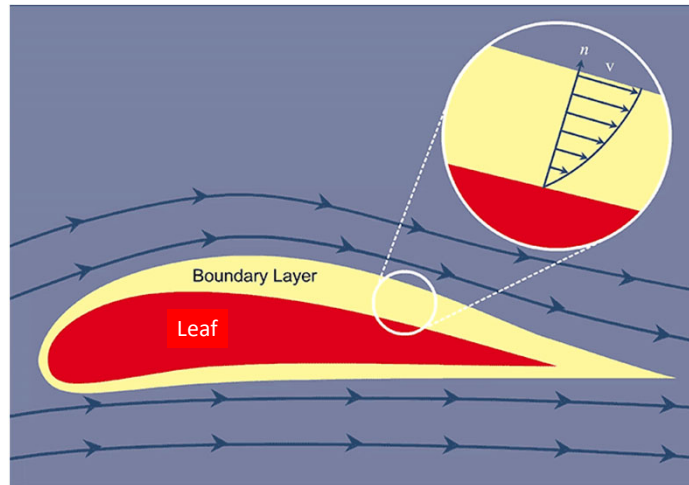
0.1 m s⁻¹ or less

With fans in crop head space

0.1 – 0.5 m s⁻¹

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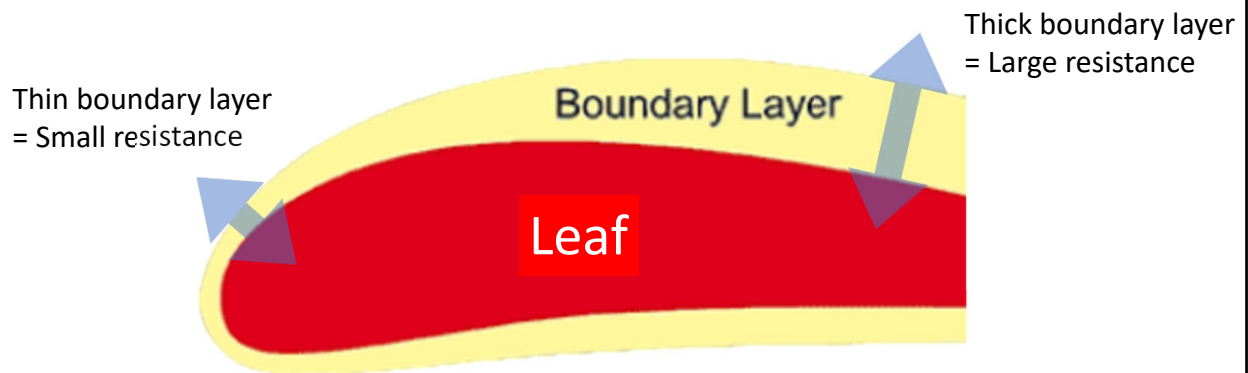
Boundary layer around leaves limit gas and heat exchange rates



<https://howthingsfly.si.edu/media/boundary-layer-0>

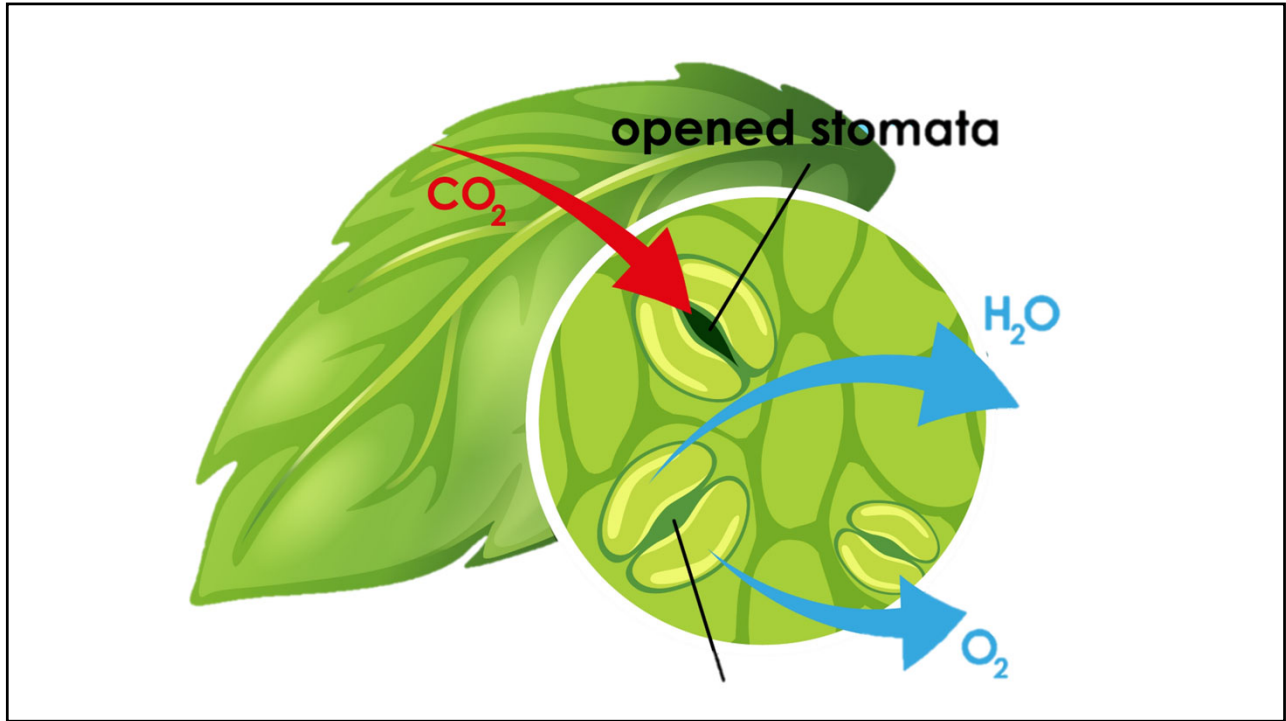
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Boundary layer **thickness** = resistance

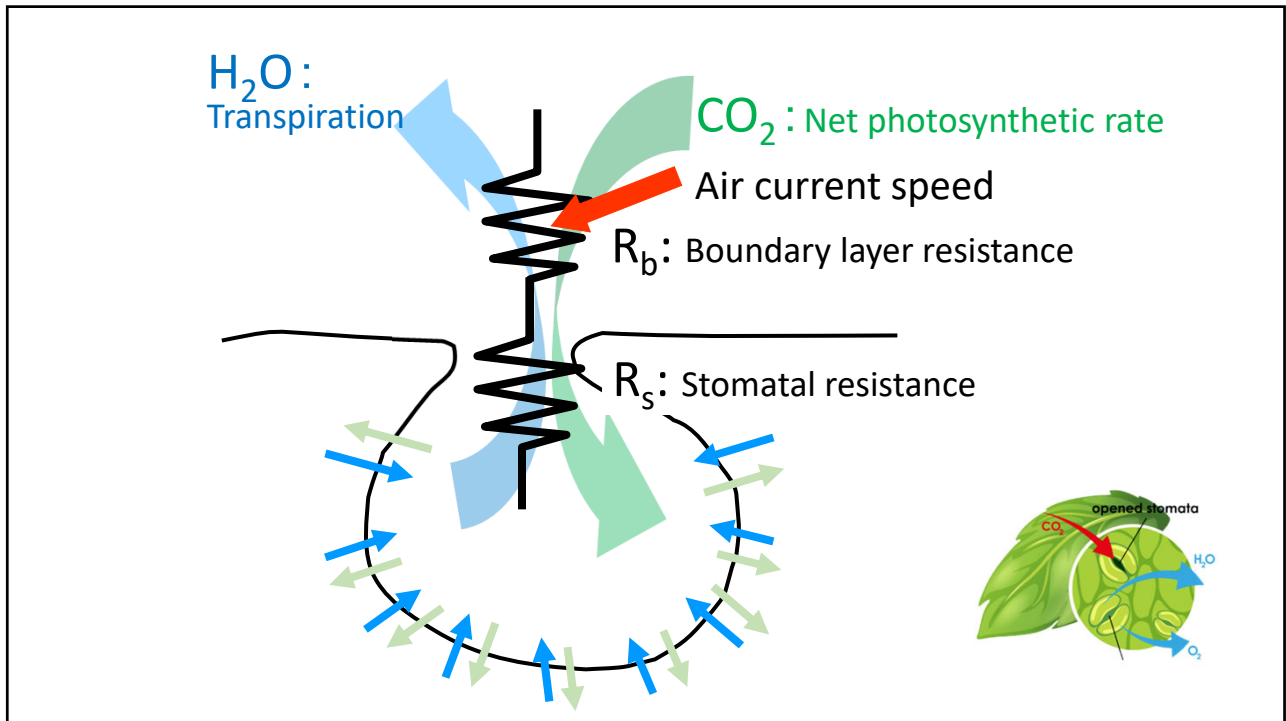


✓ **Boundary layer becomes thinner at greater air current speed.**

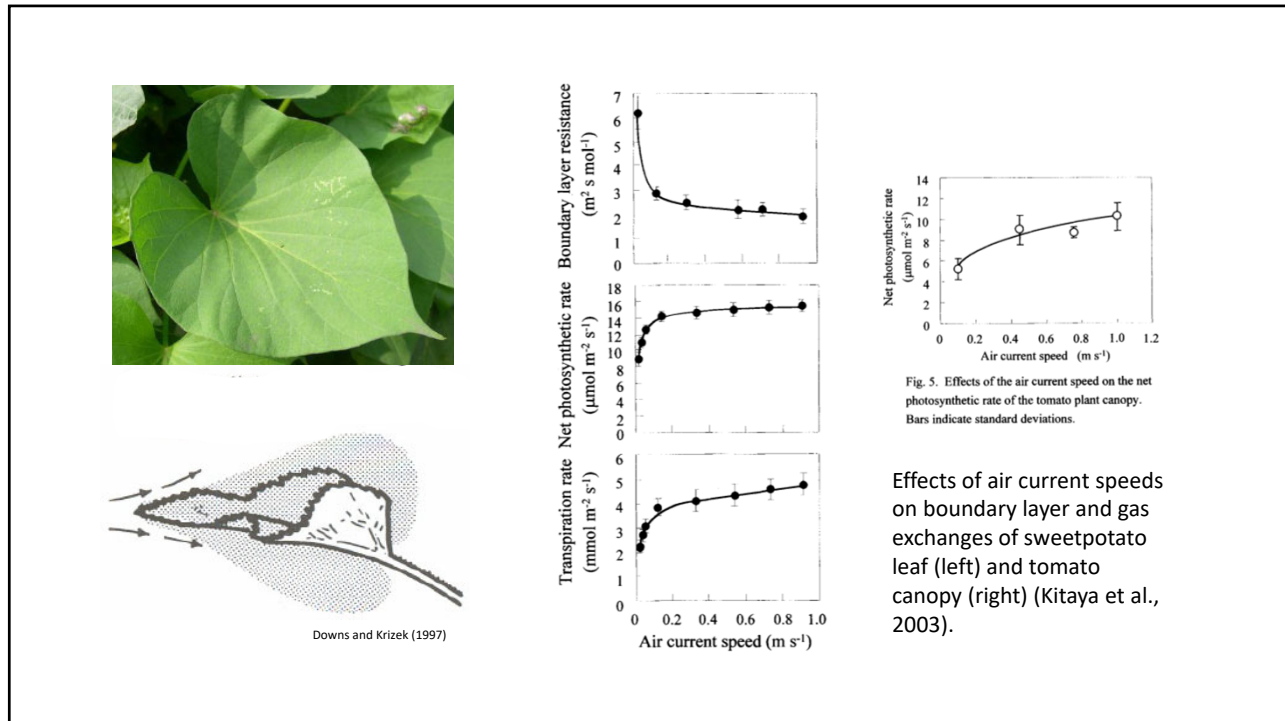
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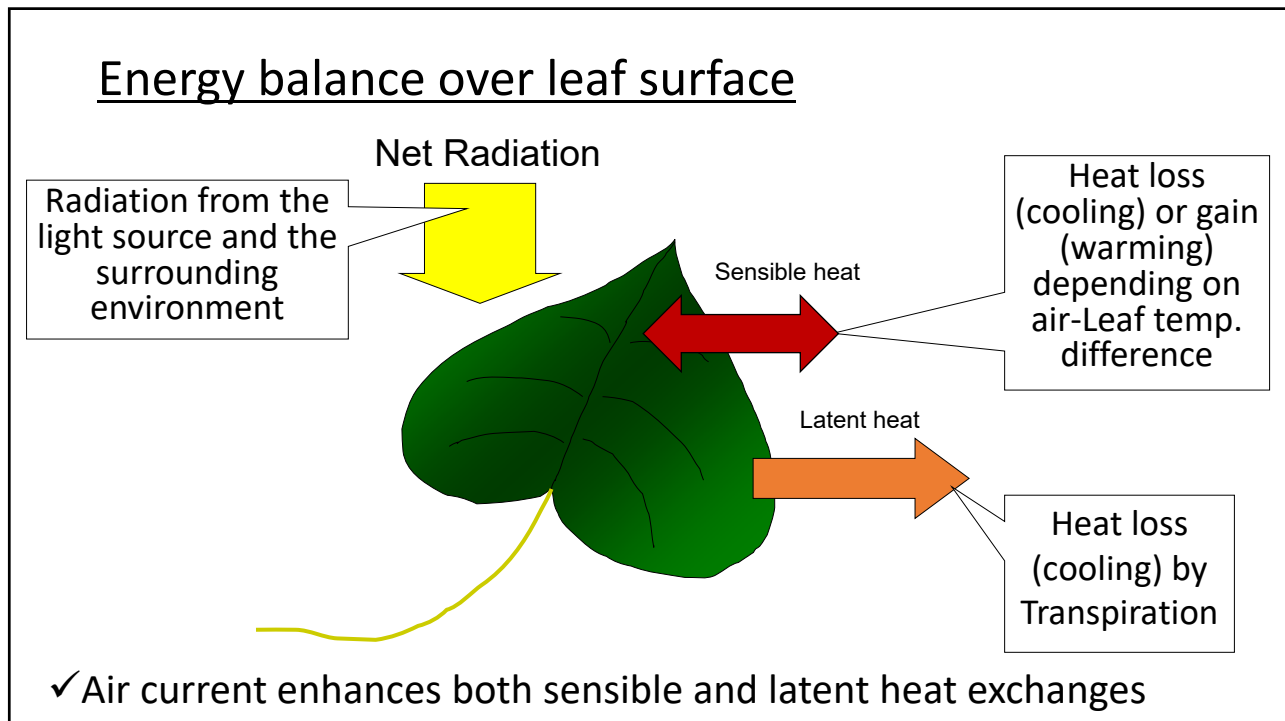
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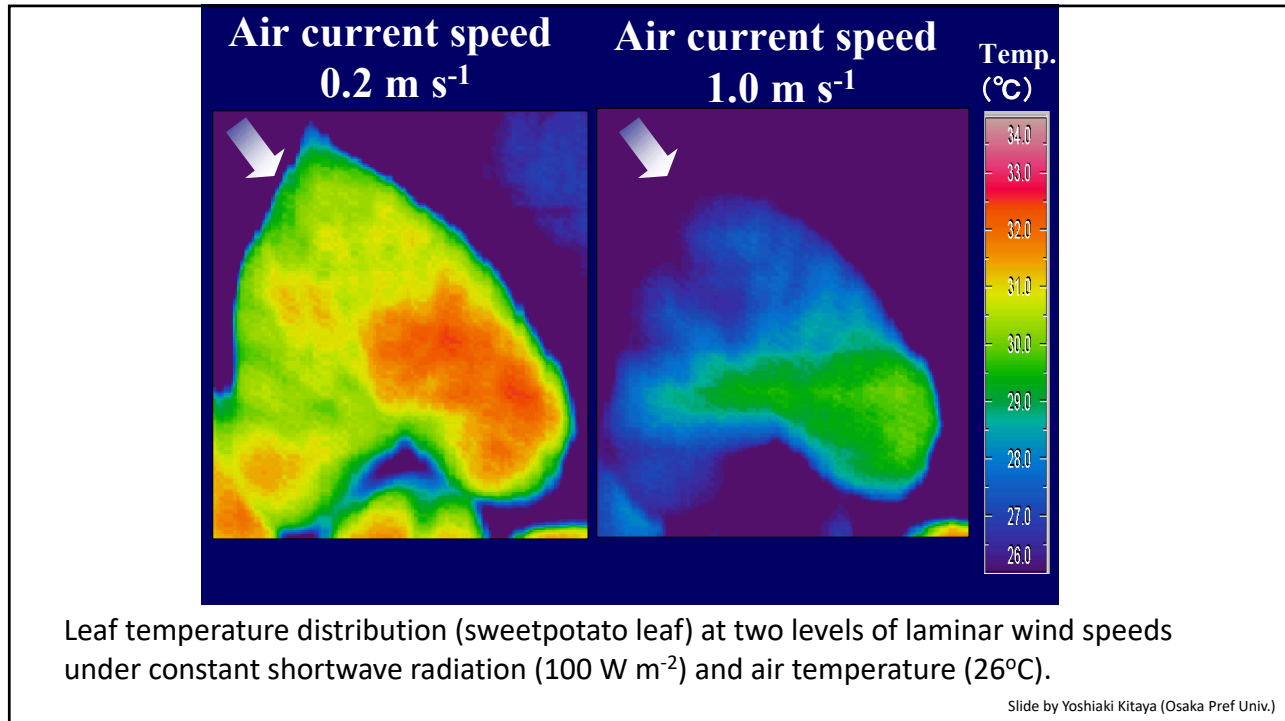
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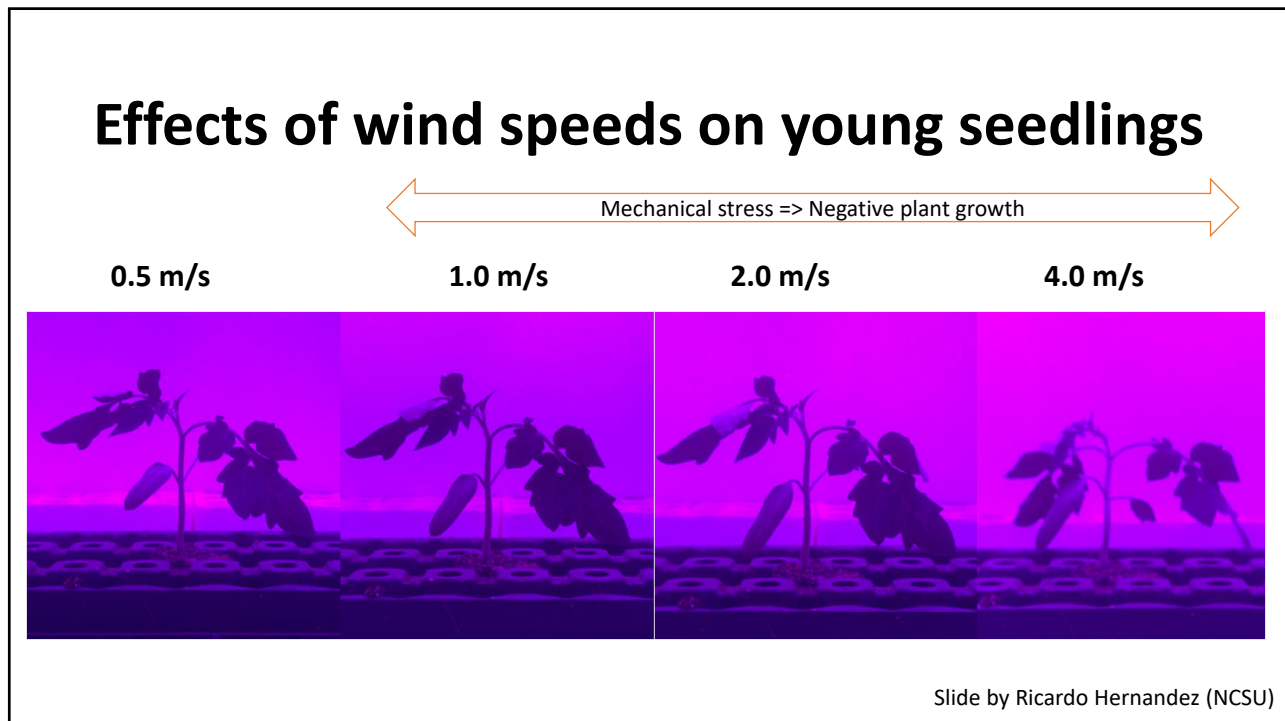
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Summary

- Air circulation around plants is an important factor affecting plants.
 - Boundary layer gets thicker and creates more resistance to photosynthesis and transpiration of leaves as air current speed decreases.
 - Thicker boundary layer also limits heat exchange with the surrounding air and increases leaf temperature.
- Optimum air current speed around plant leaves or canopy is 0.5 m/s (~ 1 mile/h).

Air current speed = 0.5 m/s



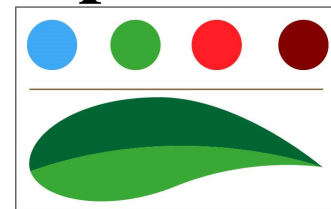
Courtesy by Ricardo Hernandez & Brandon Huber (NCSTU)

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Thank you!

For questions, please contact:
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