Airflow Machines for Cold Injury Protection

Hugh W. Fraser
OTB Farm Solutions
St. Catharines, ON
hughfraser13@gmail.com
Why is there more cold injury in recent years?

- Planting trees in more cold-prone areas
- More cold-sensitive varieties being planted
- Trees shorter, so branches are closer to where cold settles
- Orchards more dense, restricting natural flow of cold air
- More airflow ‘dams’; buildings, roads, sound barriers
- Climate change, unpredictable weather patterns, earlier blooms

There is evidence that bloom dates are getting earlier over time over in Niagara
Date of 50% Bloom; *prunus davidiana* Trees, Vineland Station, ON

Bloom Date has gradually gotten earlier over past 61 years

(latest ever was May 11, 1956)

(earliest ever was March 24, 2012)

Trendline for bloom date is getting 1 day earlier... every 5 years
What does any airflow machine need to do?

• Work in orchards of various sizes, shapes and topography
• Work when you need it, since even minutes of spring (or fall) frost, or extremely cold events in winter can be deadly to crop
• Keep temperatures above danger level, sometimes many hours
• All depend on temperature inversions to work properly
• Air temperatures in orchard monitored in real time, at crop level
• Be cost-effective, with emphasis on effectiveness, not cost

So much capital is invested in growing apples now (land, drainage, trees, trellis) that accepting losses in multiple seasons is not sustainable
What happens during a temperature inversion?

- Imagine a **glass of liquids with different densities**
  - Oil (least dense) on top of
  - Water (medium density) on top of
  - Corn syrup (most dense) at the bottom
- This is like **air during an inversion**
  - Warm air (least dense) on top of
  - Cooler air (medium density) on top of
  - Cold air (most dense) at the ground

*If we want to get the warm air down to the crops to warm them up, we have to ‘go up & get it’*
Portable, vertical airflow equipment

- Sump-pumps for cold air, instead of water
- Cold air pulled in from base, then blown up, hopefully into warm inversion layer above
- Theory is this forces warm air to fall to crop
- Its main benefit is getting cold air to move down low draw slopes to it
Portable, vertical airflow equipment (2)

- Place equipment in **low draws where cold air collects**, not flat areas; just like a basement sump-pump must be in a deeper sump hole

- Equipment is best suited for **low trapped areas, awkward-shaped fields, corners** wind machines might not reach
Fixed-in-place, diagonal airflow equipment

• Pull ‘warm’ air down from above during temp inversions, and blow it diagonally (6° to vertical), mixing it with cold air at crop level, raising temps around crop

• Equipment 35 ft up into ‘warm’ air

• Fan rotates around field like house oscillating fan, so warm air reaches large area in oblong circle (longer downslope), coming back to original location in 4 to 5 minutes

• If longer, cold air might do damage
Fixed-in-place, diagonal airflow equipment (2)

• Shape of land protected is like an oblong circle, longer in direction of land slope, as air drifts downhill like water would flow

• Reports during frost events
  • **Spring**: ‘You could draw a pencil line where frost on grass stopped and started’
  • **Fall**: ‘There was a line where (grape) leaves were alive, then dead outside the protected area’
  • **Winter**: ‘My glasses fogged up when the warm air from above hit my (cold) glasses’
Fixed-in-place, diagonal airflow equipment (3)

• Most popular equipment for frost control as it covers large acreages; tens of thousands out there across the world

• Highest cost option, but good track record for reliability, especially on large, flat acreage

• Monitoring air temperatures at crop level is key for this, or any, cold injury protection system

There were no wind machines used in Ontario apple orchards in 2009...now about 250
Portable, diagonal airflow equipment

• Like traditional wind machine, except they can be moved to other fields
• Not as high as wind machines at 27 ft, but some warm air is at this level
• Won’t cover as much area as fixed machines, but could supplement systems, or work in odd, small fields
• Flexible for crops not always in same location; berries, containerized plants

New to Ontario last couple of years and only a few currently used
For more information

• 40 copies of an 8 page factsheet on wind machines I wrote when I worked for the Ministry of Agriculture

• Or, go on-line to find it
  http://www.omafra.gov.on.ca/english/engineer/facts/10-045.htm

• Or, for a video on wind machines
  http://www.omafra.gov.on.ca/english/crops/hort/videos.htm

Thanks for your attention!