Airflow Machines for Cold Injury Protection

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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

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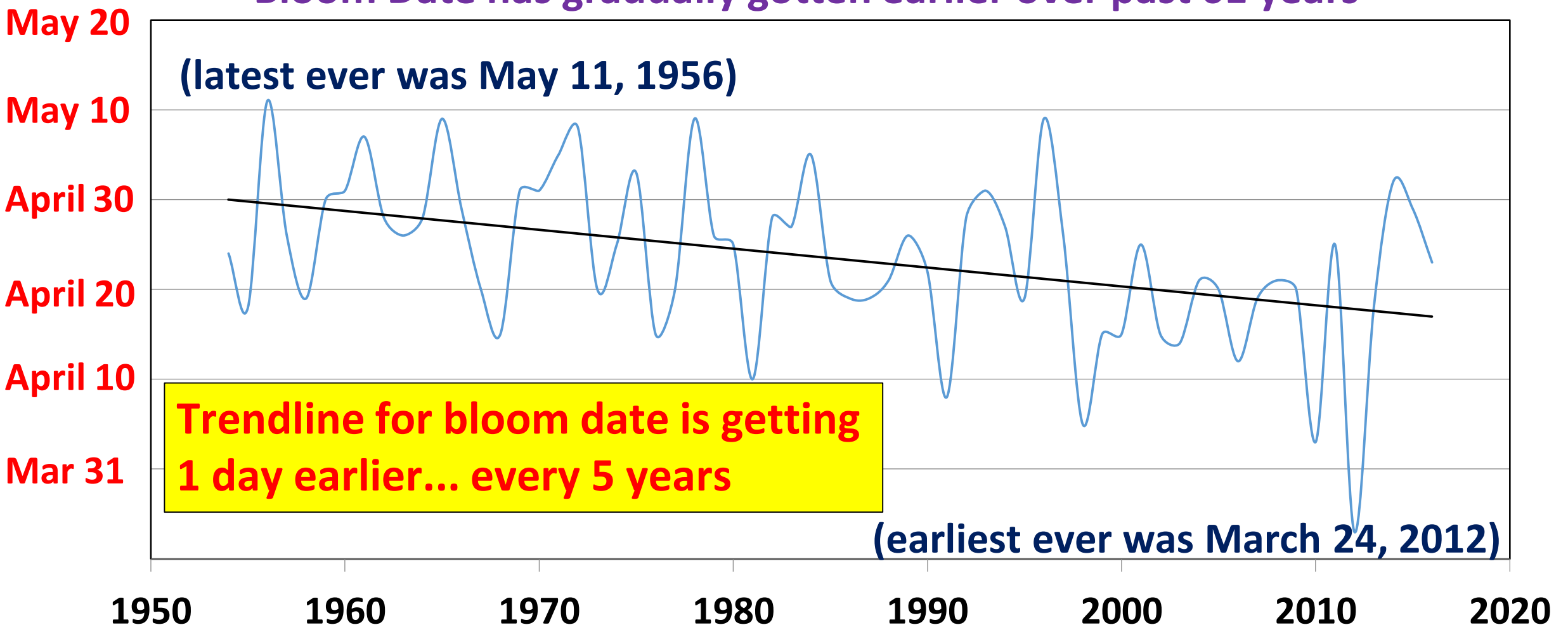
Date of 50% Bloom; *prunus davidiana* Trees, Vineland Station, ON

Bloom Date has gradually gotten earlier over past 61 years



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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

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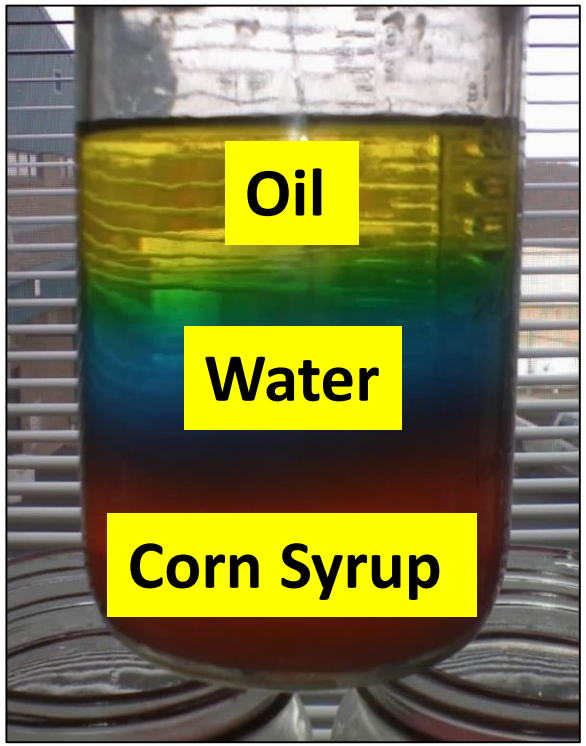
What happens during a temperature inversion?

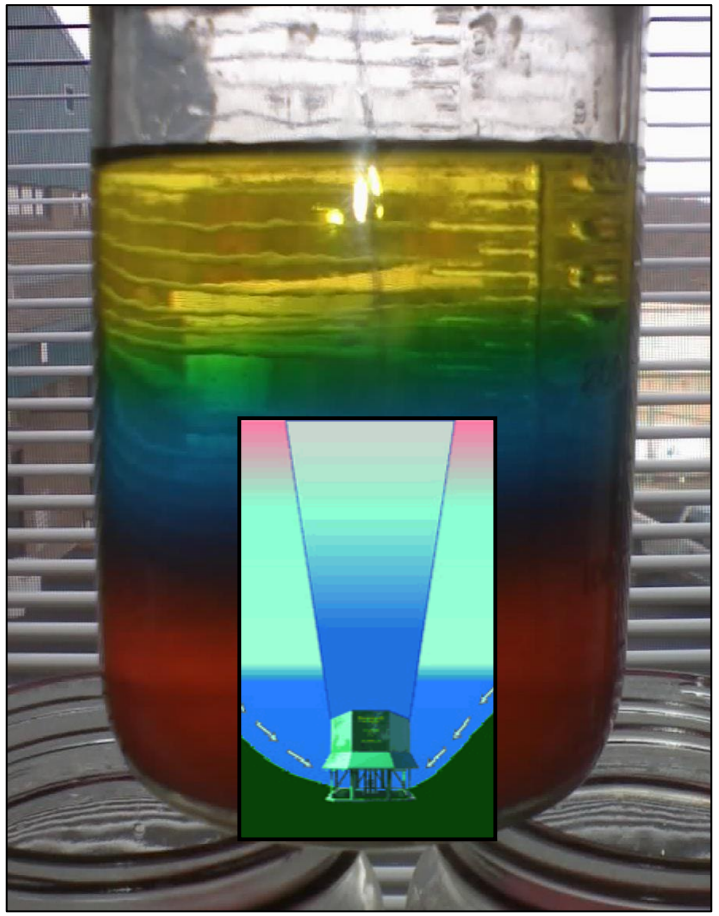
- **Imagine a glass of liquids with different densities**
  - Oil (least dense) on top of
  - **Water (medium density) on top of**
  - **Corn syrup (most dense) at the bottom**
- **This is like air during an inversion**
  - Warm air (least dense) on top of
  - **Cooler air (medium density) on top of**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

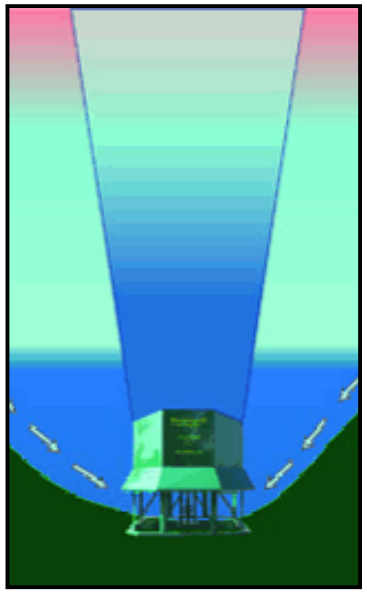


If we want to get the warm air down to the crops to warm them up, we have to 'go up & get it'

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**





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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**

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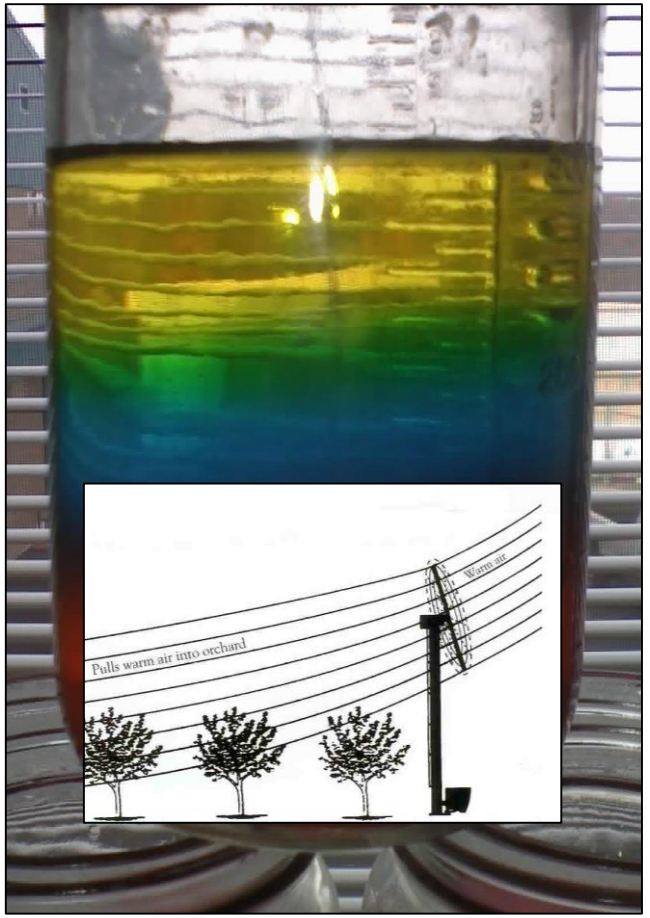
Fixed-in-place, diagonal airflow equipment

- **Pull ‘warm’ air down from above during temp inversions, and blow it diagonally (6º 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**



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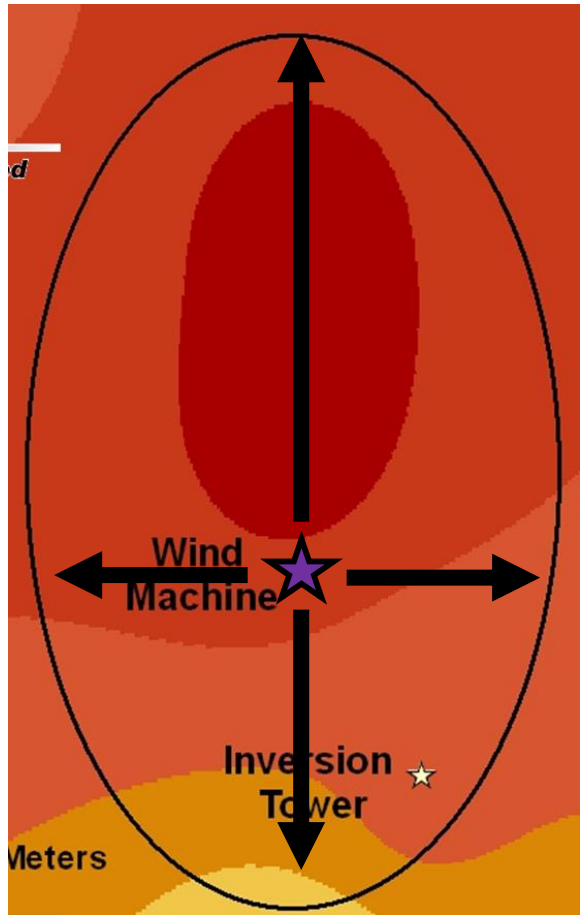
Fixed-in-place, diagonal airflow equipment (2)

- 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!

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