24ième édition : BLEUET EN CORYMBE - 5 décembre 2019

West Central Michigan Winter Damage to Blueberries 2013-2015

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LES Journées HORTICOLES & GRANDES CULTURES

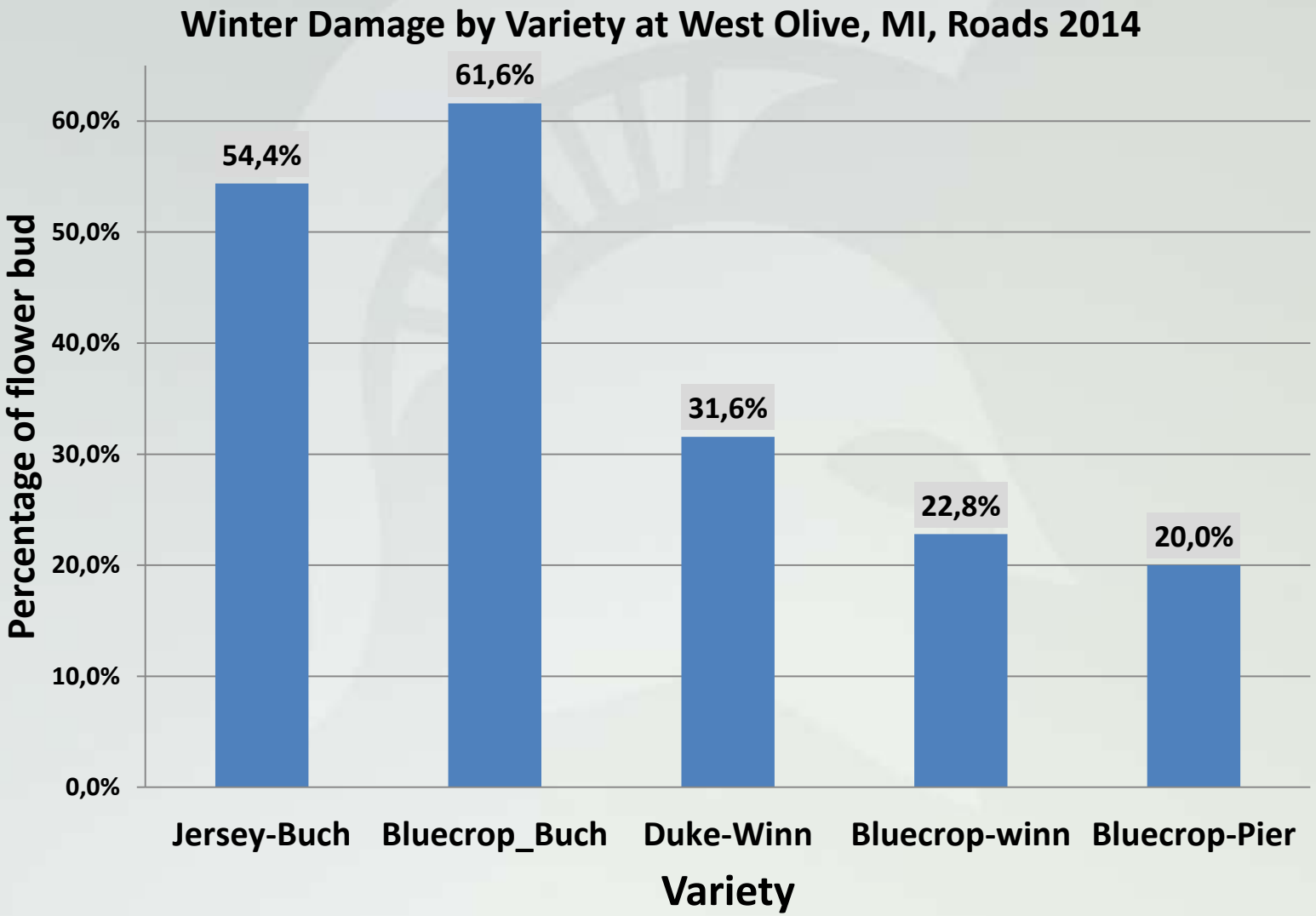
Sampling

- Sampling of 16 blueberry fields
- Locations:
  - Ottawa County at Grand Haven, West Olive and Holland, MI.
  - Allegan County at Glenn and Pullman, MI.
  - Port Sheldon Road.
  - US-31 Highway (2 sites)
  - Michigan Drive (M-45)
  - 120th Ave & Pierce St.
  - Buchanan St.
- Twenty shoots; 20 from plants facing the road and 20 from plants 100 feet away from the road.

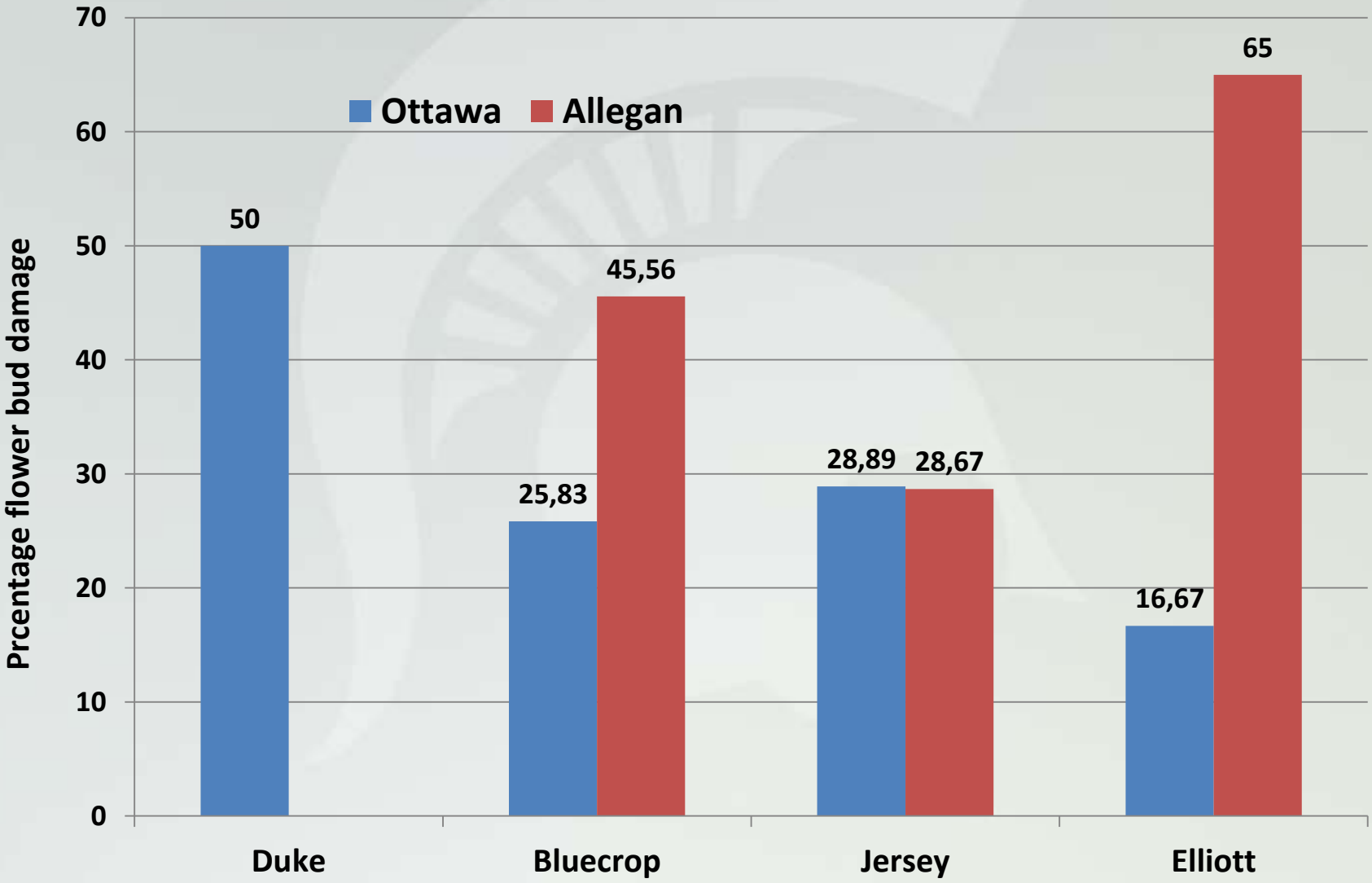
Sampling before “bud break”

- Three buds for each shoot evaluated by dissecting the bud under a microscope.
- Percentage of flowers with visible damage (partial or total) recorded per variety and field.

Damage by variety



Winter Damage to Flower Buds: March 23, 2015



Impact on blueberry crop 2015

- A decrease in the blueberry crop for 2015.
  - Jersey and Bluecrop approximately 28%
  - Elliott depending of the location between 16 and 60%.
  - Duke around 50% depending on the location.
- Extensive pruning of winter damaged fields

Polar Vortex 2018: Winter Damage

Winter weather conditions in 2018 were mild for the most part, there were some days when the daily minimum temperatures fluctuated between -17.7 and -12.5 degree Celsius. Those temperatures occurred on January 4th and 5th and on February 12, 2018.

Bluecrop field with winter damage. Bushes are with flowers but not bud leaves and shoots look reddish brown. (Zeeland, MI. MSUE Carlos Garcia)

Winter Damage April 23, 2019 “Green Tip”

Temperatures in January 20 and 21 registered in the area were -12 and -8.5 degrees Celsius.

On January 30, 31 and 1st of February minimum temperatures were -15, -16.6, and -17.5 degrees Celsius. And again on February 19 with -16.2 degrees Celsius.

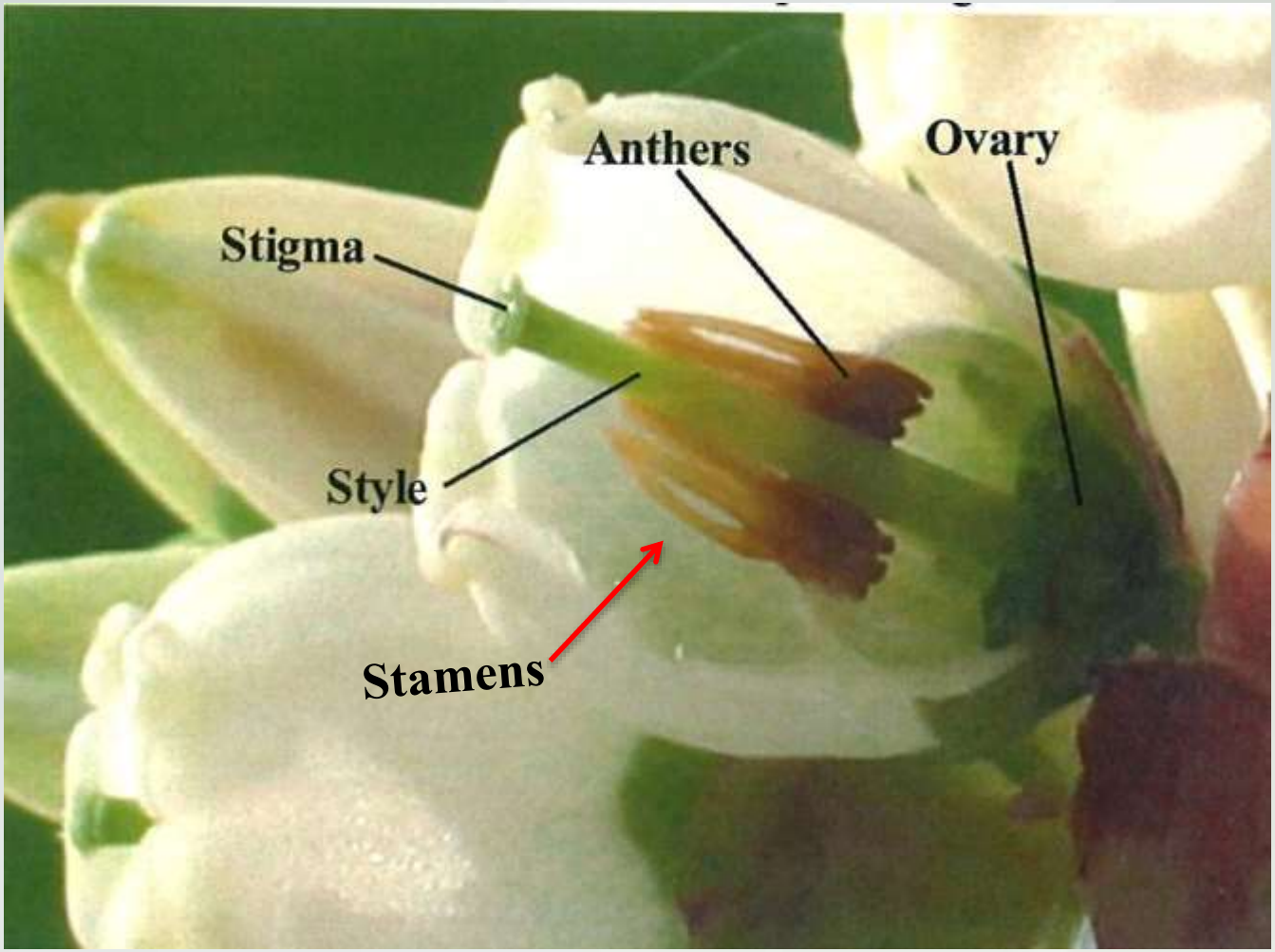
At difference of 2018, minimum temperatures were not followed by temperatures above the blueberry’s threshold temperatures for development; 7 – 8.5 degrees Celsius.

Bluecrop variety. Shoot tip showing the terminal flower completely blackened and a lateral flower bud partially damaged.

Bluecrop variety. Flower bud showing blackened stamens which are symptom of winter damage.

(Photographs: Carlos Garcia, MSU Extension)

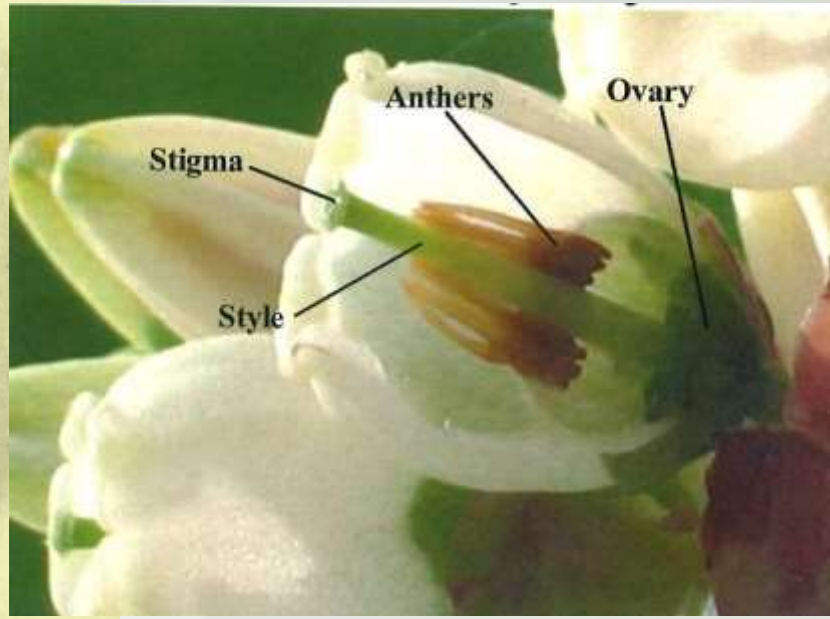
Dissected healthy blueberry flower with organs



Dissected blueberry flowers for frost damage inspection

Anthers and stamens Damaged

Ovary and anthers damaged



Blueberry flower with healthy organs

(Photographs: Carlos Garcia, MSU Extension)

Winter Damage: Problems observed

Varieties at risk are Bluecrop, Duke and any other early season varieties.

Varieties with large percentage of flower buds in “Late Pink” stage.

- Lack of reliable weather information.
  - Especially small grower do not have access to an appropriate source of hourly weather information to make decisions about to when to start frost protecting.
  - The automatic weather network has limited value for growers that do not have access to internet or are too far from the nearest station.

Winter Damage ..cont

- Frost protection decision making requires on-site timely reliable information.
- Deficient or inefficient Irrigation System.
  - Overhead sprinkle irrigation is not the most efficient frost protection tool.
  - Design and deficient overlapping cause waste of water that falls to the ground away from plants with no use for frost protection.
- Problems with surveillance and maintenance of impact sprinklers during the frost protection periods.

Recommendations for frost protection

- Before starting your frost protection program, conduct an evaluation of the percentage of flower bud mortality due to winter conditions.
- Calibrate your sprinkle irrigation system to make sure that everything works properly and that there are no gaps.
- Frost alarms and alerts are especially valuable if your field is further than walking distance away from where you live.
- If water is limited, give priority to early varieties.
- Do not turn on the irrigation system if the flower bud development still is at a safe state.
- After each freeze/frost event, check the percentage of flower bud damaged.

Frost Protection of Blueberries

When to Frost Protect?

- Early?
- Late?
- Not at All?

Critical Temperatures

- Temperatures needed to cause freezing damage to buds or flowers.
- Critical temperature is low at beginning of bud development and rises at buds grow and flowers are exposed.

Blueberry Critical Temperatures

This stage can tolerate 15 to 20 F or –7 to -10 C.

This stage can tolerate 25 to 27F or –4 to –3C.

This stage can tolerate 27 to 28F or –2.8 to -2.2C.

This stage can tolerate 29F or –1.7C.

Types of Freeze

Radiation Freeze	Advective Freeze
Winds less than 8 KPH	Winds higher that 8 KPH
Clear sky	May be cloudy
Cold air mass 10 to 60 m	Cold air 150 to 1,500 m
Inversion develops	No Inversion
Cold air in the low spots	
White or black frost damage	
Easier to protect	Difficult to protect

Inversion

- Happens on clear nights
- Temperatures drop significantly at the surface due to radiation.
- The temperature in the lower atmosphere inverts
- The temperature increases with altitude to the top of the air layer.
- The warm air in an inversion is important for some frost protection

Frost Freeze Warnings

Definitions of frost/freeze warnings issued by United States National Weather Service.		
Warning	Wind Speed	Air temperature
Frost	Below 16 KPH	Above 32ºF (0ºC)
Frost/freeze	Below 16 KPH	Below 32ºF (0ºC)
Freeze	Above 16 KPH	Below 32ºF (0ºC)

A **frost** is when we get a visible **frost**. A **freeze** is when the air temperature drops below **freezing**. Sometimes we get **frost** when the temperatures are above **freezing** and we often have a **freeze** without **frost**. It all has to do with the amount of water **in the** air

Dew Point

- The **dew point** is the temperature where water vapor condenses into liquid water.
- All air holds different amounts of water vapor. The higher the **dew point** is, the higher the level of moisture in the air at a given temperature.
- The **dew point** of humid air will be higher than the **dew point** of dry air.

Dew Point

- The air will cool relatively rapidly to the dew point.
- At the dew point, water vapor condenses releasing heat.
- The air is now saturated for the temperature to fall
  - Condense more water from the air
  - Rate of temperature fall is lower

Irrigation and Cold Protection

- When used properly, water can provide partial or complete crop cold protection.
- Improper use of water can increase cooling causing greater damage than if no water were used at all.
- It is important to know principles involved in using water for cold protection.

Irrigation systems

- Surface
- Sprinkler
- Microirrigation

Overhead Sprinklers

- Many Blueberry growers use sprinkler irrigation systems to reduce freeze damage. Sometimes using them causes more harm than good.

Rules of Freeze Protection

- Apply water fast enough to keep ice wet all the time.
- Apply enough water to protect the plant.
- High system uniformity is necessary for effective frost protection.
- Overlap is extremely important for frost/freeze protection.
- Higher winds require closer spacing of sprinklers.

When to start?

To avoid damage under low dew point conditions, sprinklers should be started at:

- 1.1° C (34° F) if the dew point is -4.4° C (24° F) or above
- 1.7° C (35° F) if the dew point is -6.7 to -5.0° C (20-23° F)
- 2.2° C (36° F) if the dew point is -9.4 to -7.2° C (15-19° F)

This recommendation should only be followed when a frost is predicted.

Sprinklers may be turned off when the air temperature has risen to 1.1° C (34° F).

Ice Forming Indicator

- The temperature of a plant covered in ice will drop below a dry plant if the ice dries.
- Evaporation from the ice will cool the plant below the air temperature.
- Wind speed greatly reduces effectiveness of sprinkler irrigation for freeze protection.

Ice forming indicator

The color of the ice forming on plants is very important. If the system is properly working, the ice will be clear.

Ontario's experience with wind machines

- None in 1995; 700+ now; 90% in grapes
- Apples, nectarines, peaches, plums, sour cherries & '3' on one blueberry farm!
- Washington/BC blueberries have many machines


Ontario blueberries


Washington

What protection can you anticipate?

- 4 – 6 ha protected based on machine/farm
- **Raise air temperatures ≈ 40% of difference between air temperature high above crop and air temperature at crop level**
- Eg. air at berries -2°C; air above 3°C; so could raise air temperature 40% of 5°C (2°C) to 0°C
- **……*BUT* if air at berries is -6°C, you cannot raise air temperatures high enough to protect crop!**

QUESTIONS?