Taking a Closer Look: How Strawberry Disease Risk Varies with Microclimates at the Canopy Level

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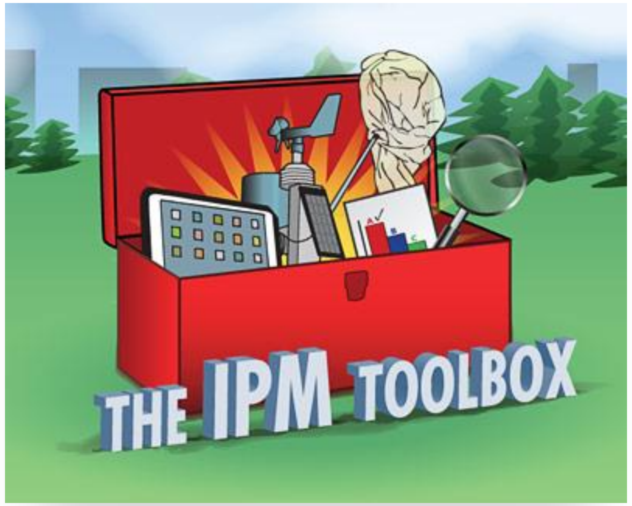

Northeastern IPM Center

May 4, 2022

Webinar Details

Welcome

A recording of this webinar will be available within a week at

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We Welcome Your Questions

Please submit a question **at any time** using the Q&A feature to your right at any time

If you'd like to ask a question anonymously, please indicate that at the beginning of your query.

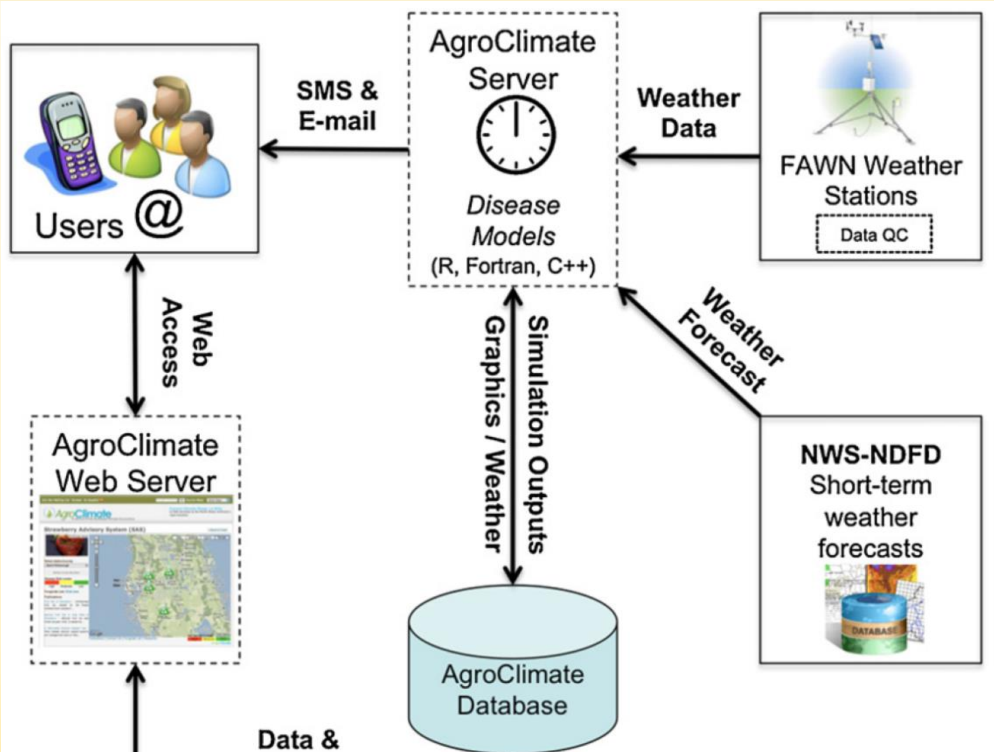
Webinar Presenter

- Dr. Mengjun Hu

Some Questions for You

Disease prediction model/system

- Infection risk for Botrytis and anthracnose fruit rot (BFR and AFR) can be predicted using disease models based on **leaf wetness duration and temperature**



Pavan et al. 2011

Application of row covers in the Mid-Atlantic

- Protection from frost and freeze
- Promotion of crown and floral development

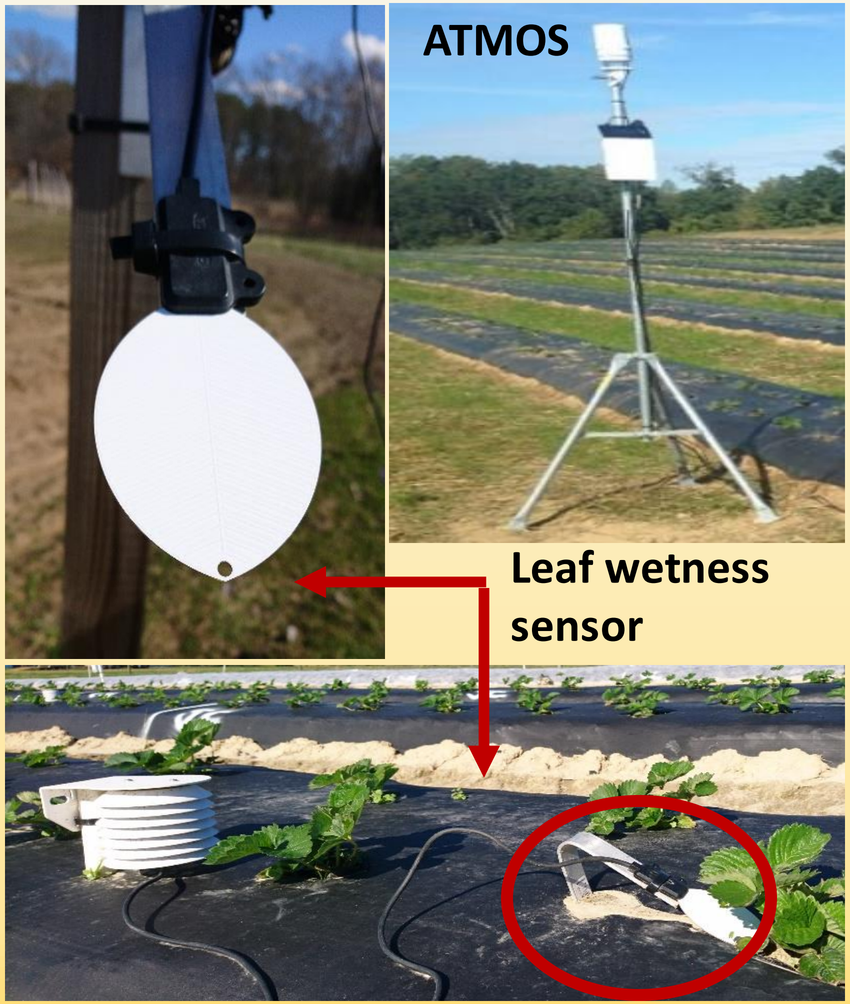
Hypotheses & Objectives

Hypotheses:

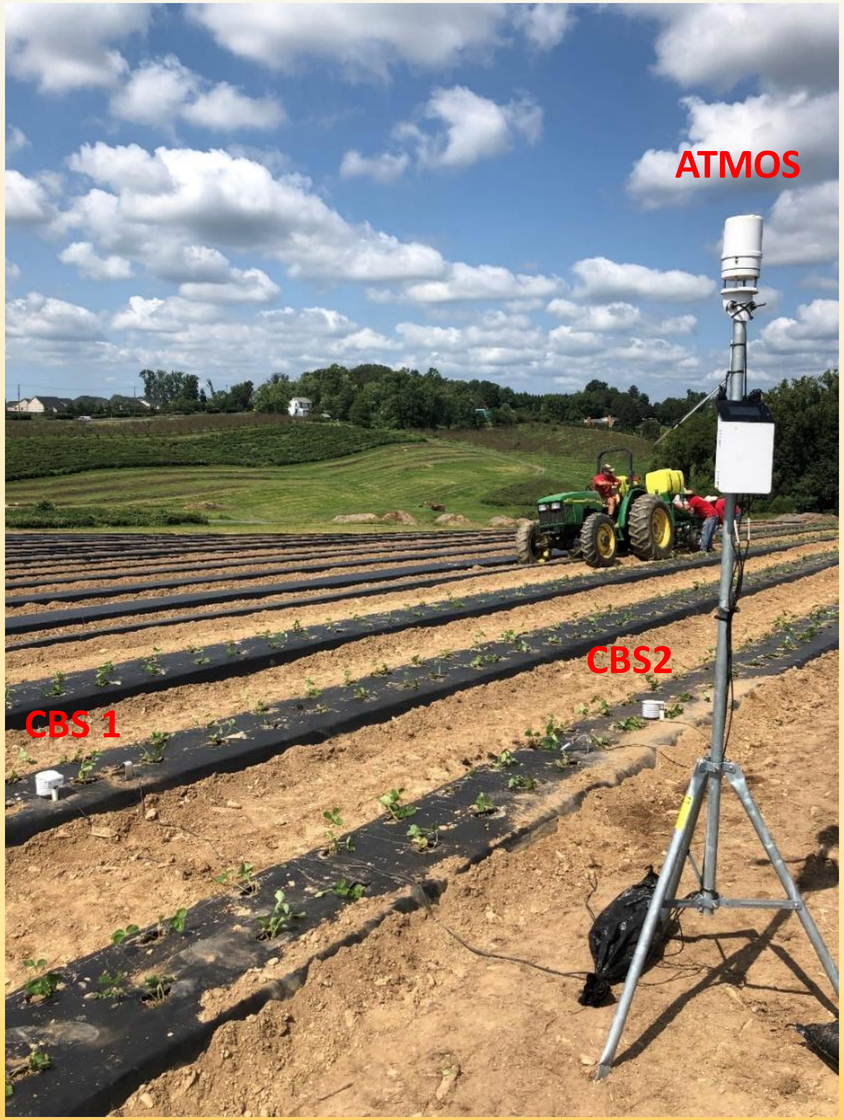
- Row cover alter microclimates at the canopy level.
- Environmental variables at the canopy-level differ significantly from conventional weather stations.

Objectives:

1. Analyze differences among environmental variable inputs and disease model outputs due to sensor placement
    - Microclimate station and weather station (ATMOS)
    - Edge and non-edge rows
2. Effects of row covers on alternating microclimates and disease risk
3. Validate the canopy-based disease risk models for timing fungicide applications for AFR and BFR control.



Experimental design

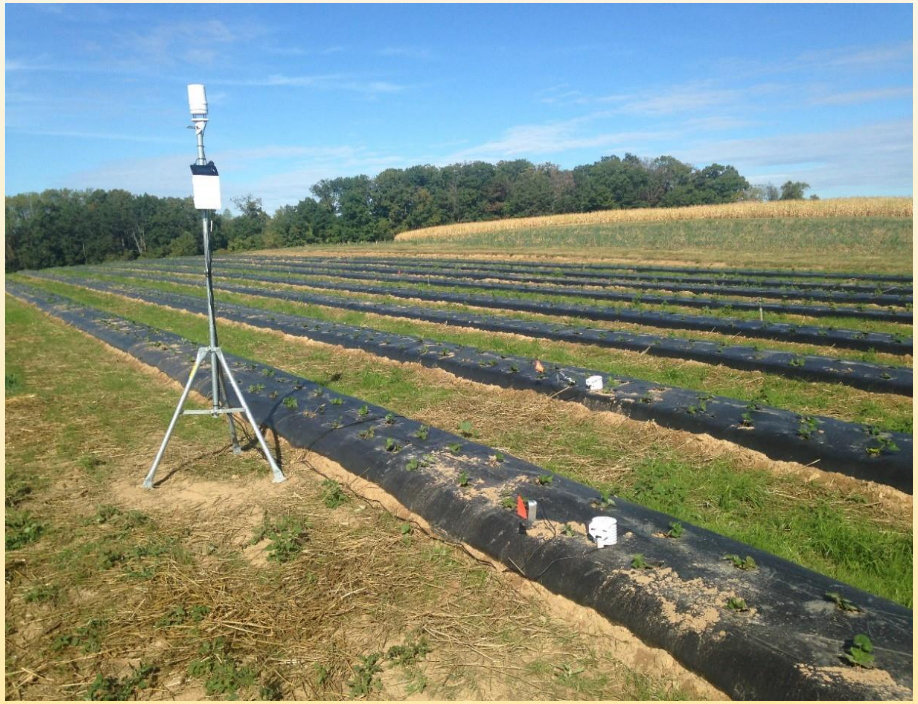


- **Treatments (timed fungicide sprays) based on**
  - Calendar (weekly)
  - Model-based
    - Traditional weather station (ATMOS)
    - Canopy-level sensors
  - Untreated control for comparison
- **Weekly evaluation of**
  - AFR and BFR incidence
  - Marketable fruit yield
- **4 sites, 2 seasons**

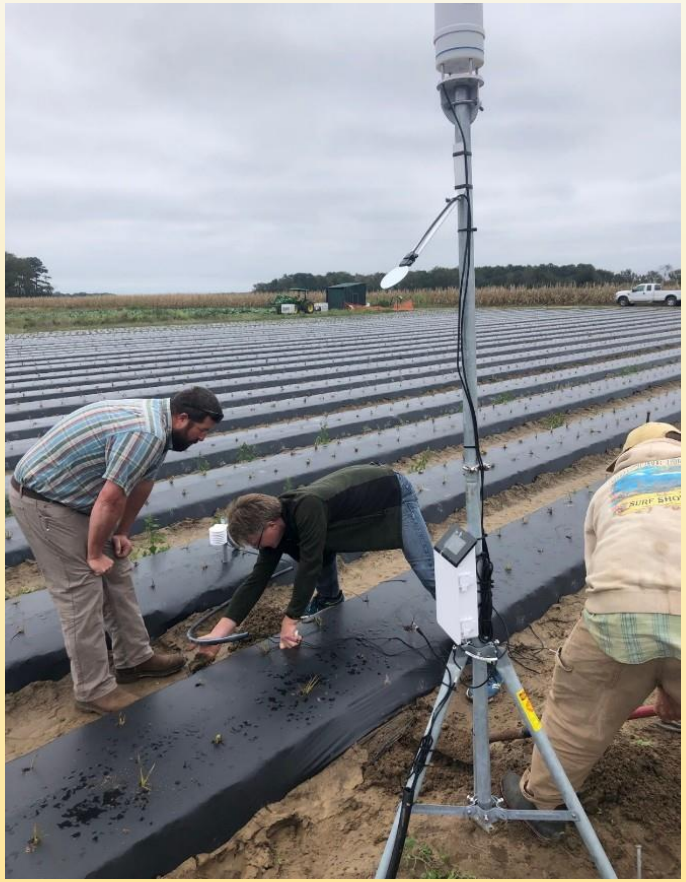
Field trial sites in the mid-Atlantic region (2019 to 2021)

Site MD1: Wye REC, Queenstown, MD

Site MD2: Germantown, MD



Site VA1 & 2: VA Beach, VA

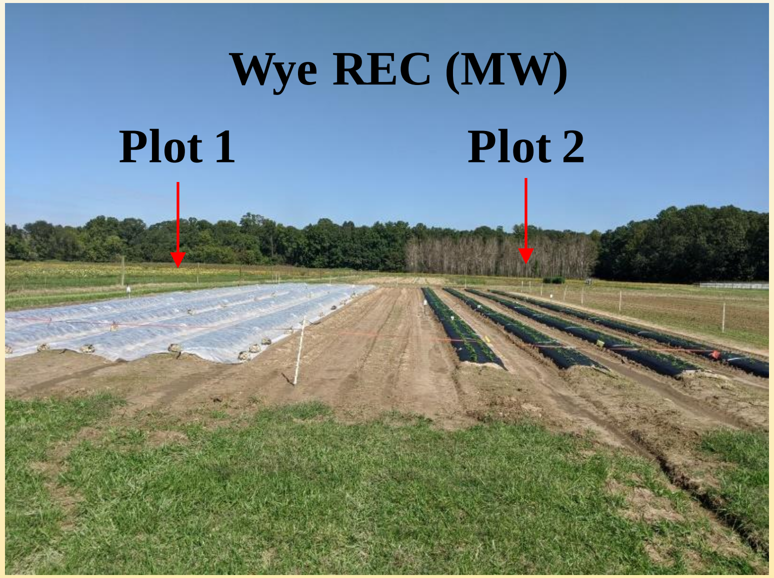


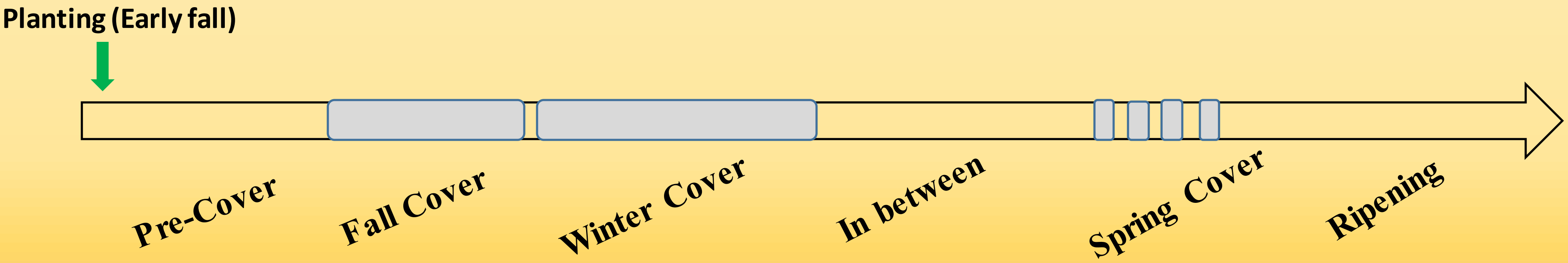
AgZoom as a weather data visualizing tool

https://www.ag-zoom.com/

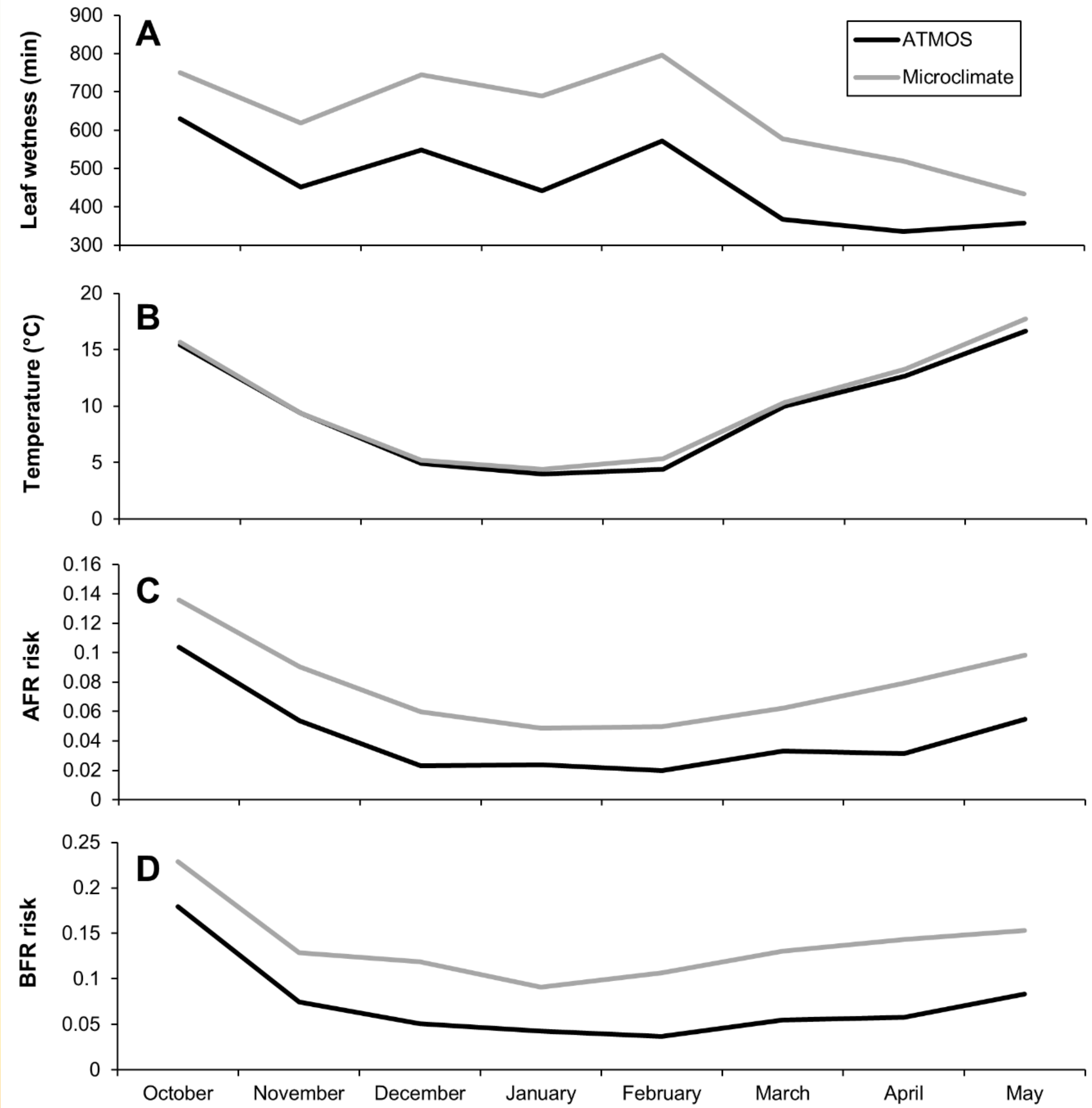
Timing of row cover deployment (2019-2021)

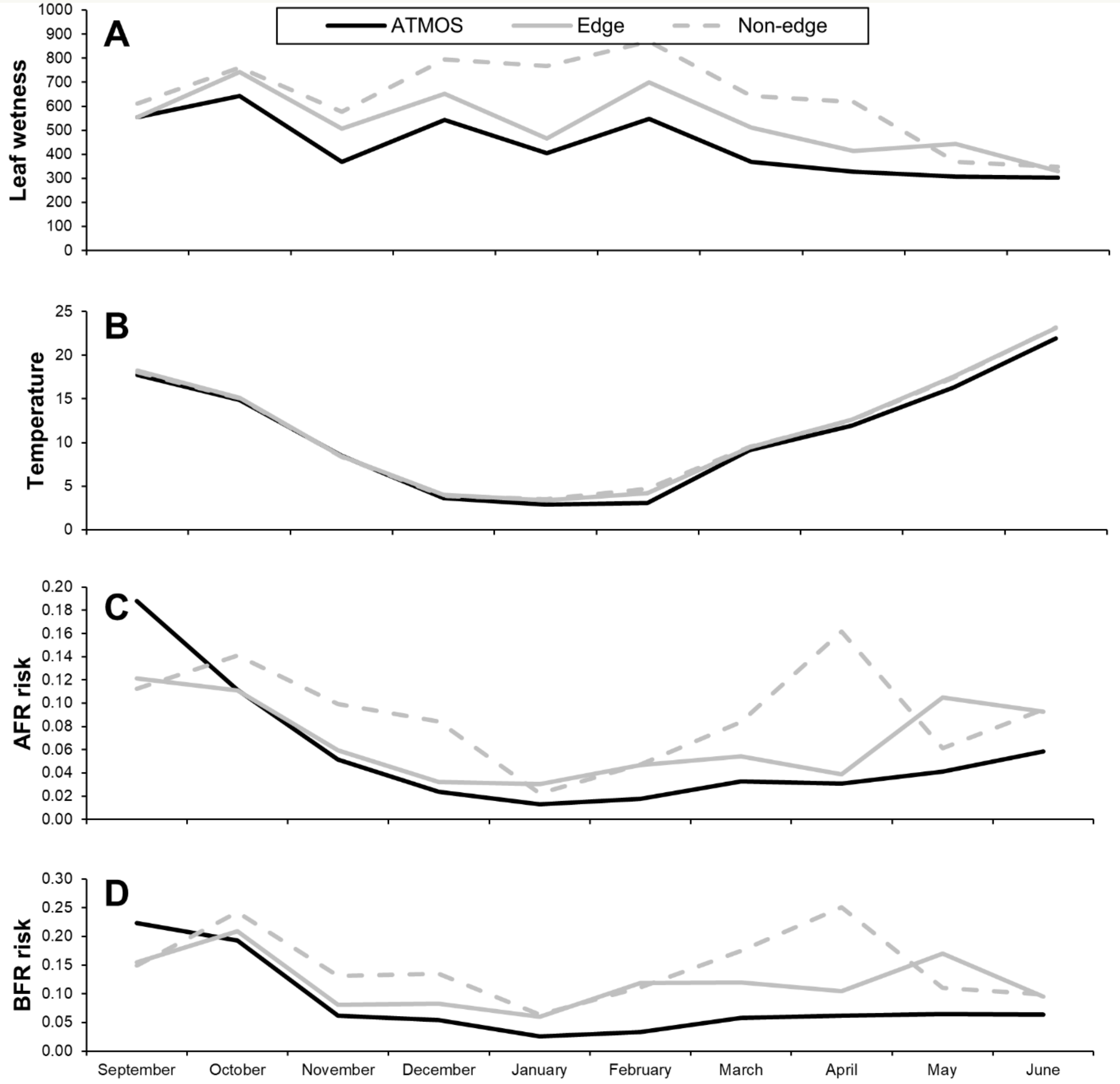
Locations	Maryland			Virginia	
	Wye REC (MW)		Germantown (MB)	VC	VV
	Plot 1	Plot 2			
Pre-Cover					
Fall Cover	Cover				
Winter Cover	Cover	Cover	Cover	Cover	
In between					
Spring Cover	Cover	Cover	Cover		Cover
Ripening					





With all sites and seasons combined





Difference in average temperature (°C) and minutes of leaf wetness per day

Variable	Site	Pre-cover	Fall covered	Fall non-covered	Winter covered	In between	Spring covered	Ripening
Temperature	MB 19/20	-0.1	- [y]	-	+0.6	+0.6	+2.3	+1.0
	MB 20/21	-0.2	-	-	+0.4	0.0	+0.4	+0.5
	MW 19/20	+0.5	+1.9	+0.1	+1.3	+0.2	+1.2	+1.0
	MW 20/21	0.0	+3.5	+0.3	+1.3	+0.7	+1.4	+0.8
	VC 19/20	+0.3	-	-	+0.6	+0.2	-	+0.5
	VV 20/21	+0.1	-	-	-	-	+3.7	+0.7
Wetness duration	MB 19/20	+214	- [y]	-	+197	+268	+135	+123
	MB 20/21	+269	-	-	+186	+184	+63	+210
	MW 19/20	-5	-143	+122	-83	+77	-125	-52
	MW 20/21	+180	-267	-47	+422	+227	+568	+246
	VC 19/20	+107	-	-	+80	+164	-	+204
	VV 20/21	+300	-	-	-	-	+275	+75

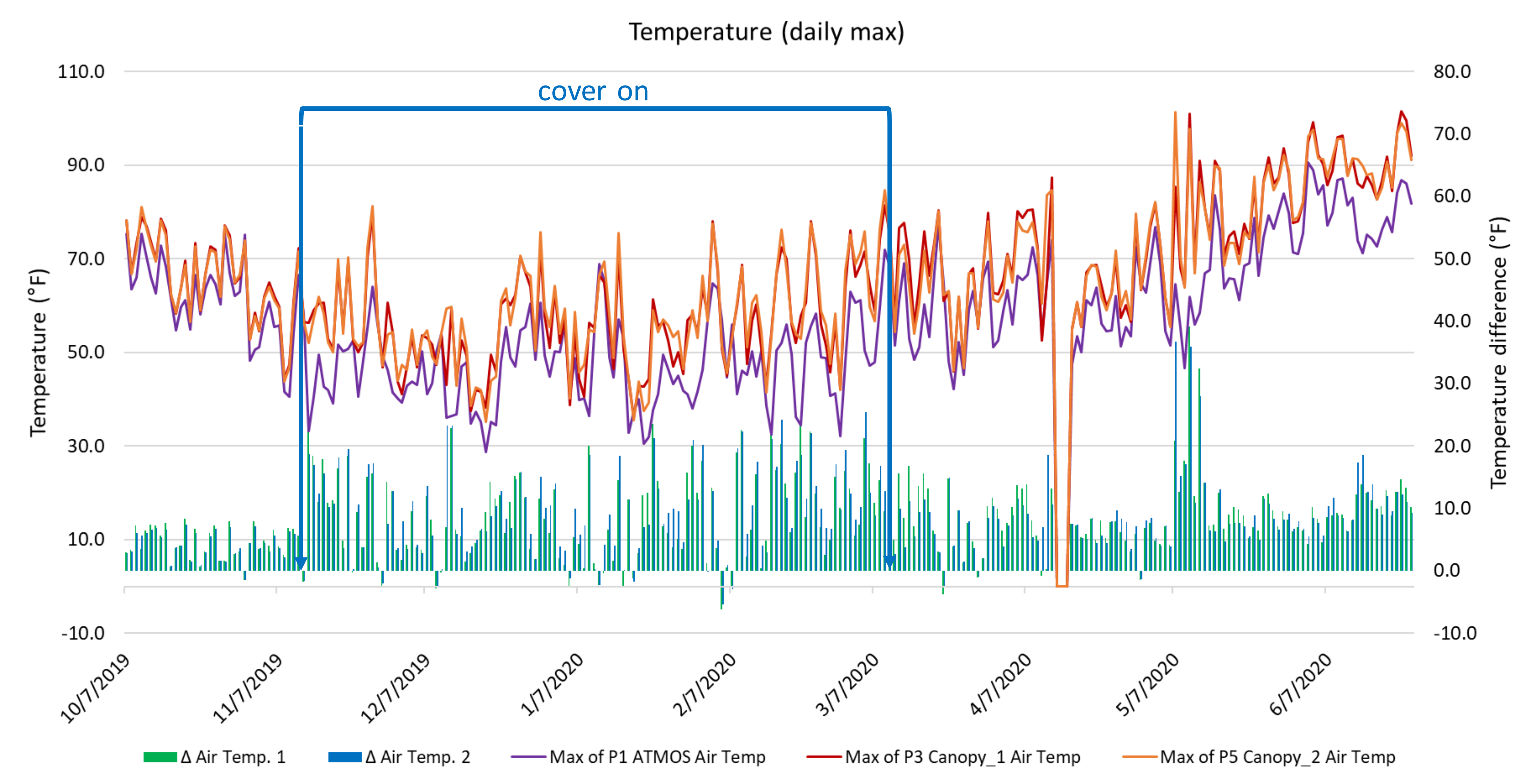
[z] The microclimate sensor values were calculated from the average of the two canopy-level sensors.

[y] Season timings with a hyphen were not included in this trial.

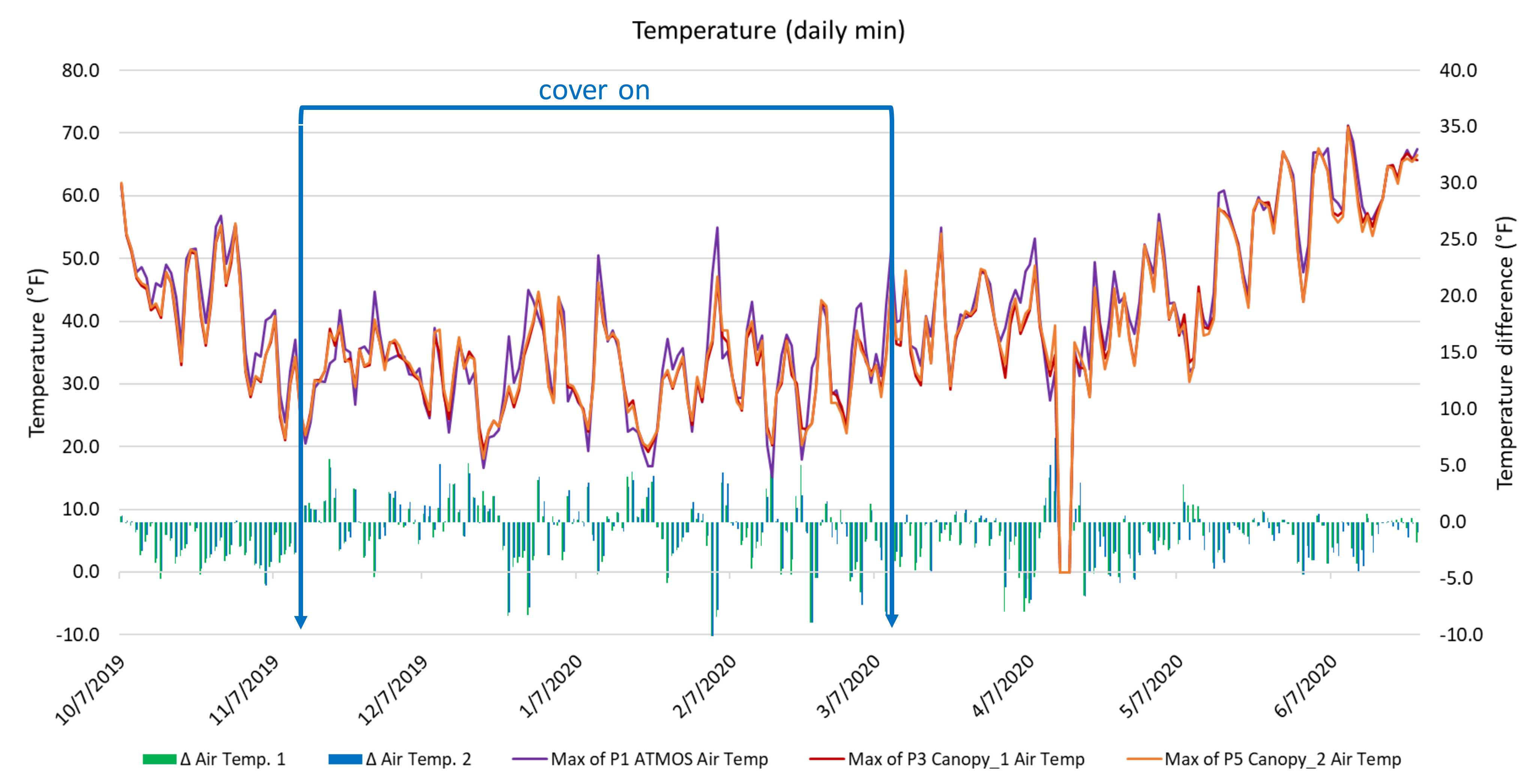
Average day and nighttime temperatures (°C) with different sensor placements during the Fall cover period

			Temperature difference from ATMOS sensor (°C)			
Day/night	**Site**	**ATMOS**	**Exterior**	**Interior**	**Exterior - Covered**	**Interior - Covered**
Day	MW 19/20	8.2	+0.9	+0.9	+4.1	+3.4
Day	MW 20/21	18.0	+1.0	+1.0	+5.9	+5.6
Night	MW 19/20	4.9	-0.5	-0.5	+0.8	+0.5
Night	MW 20/21	13.6	-0.2	-0.3	+1.3	+1.8

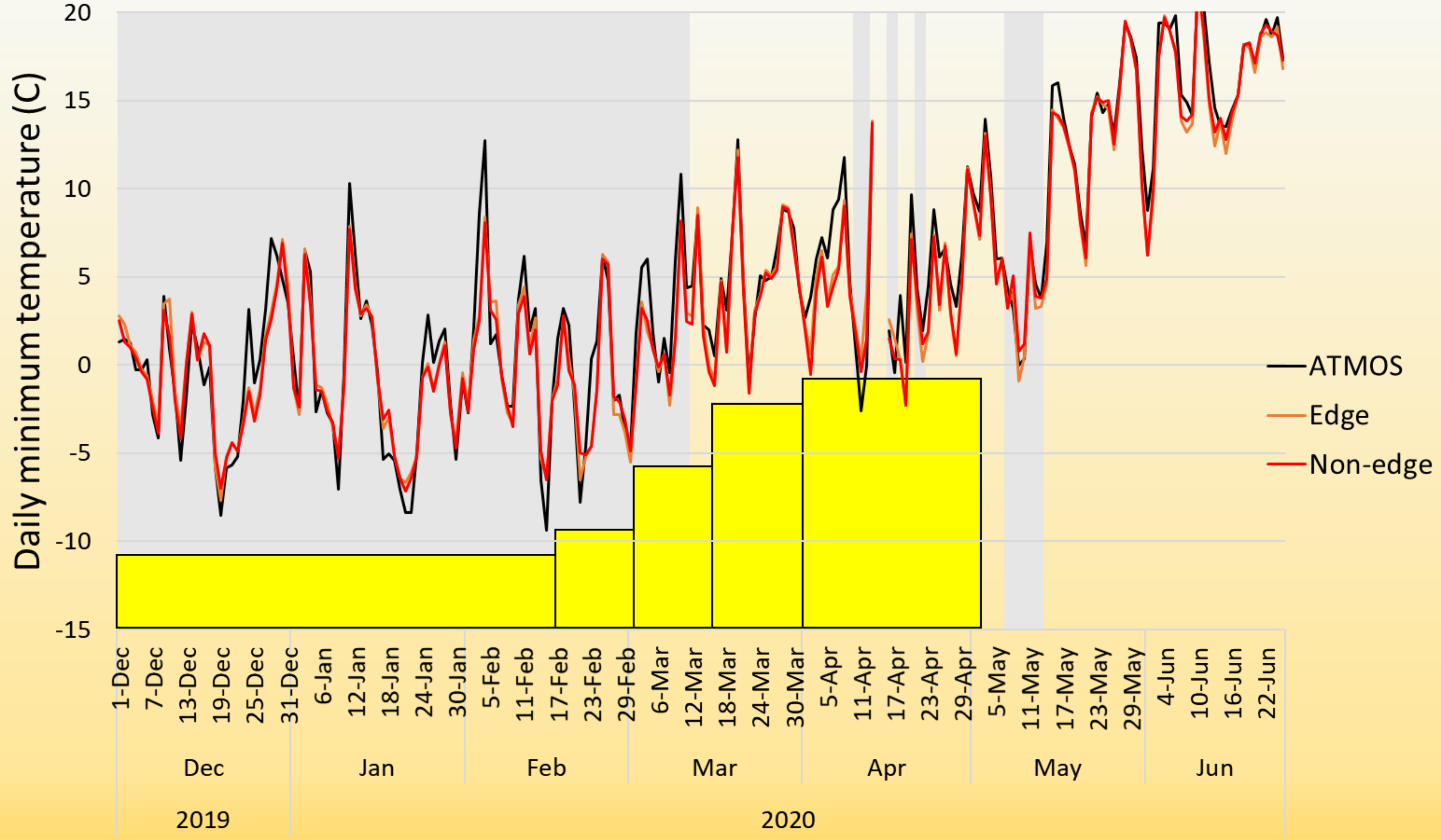
Maximum temperature higher in the canopy



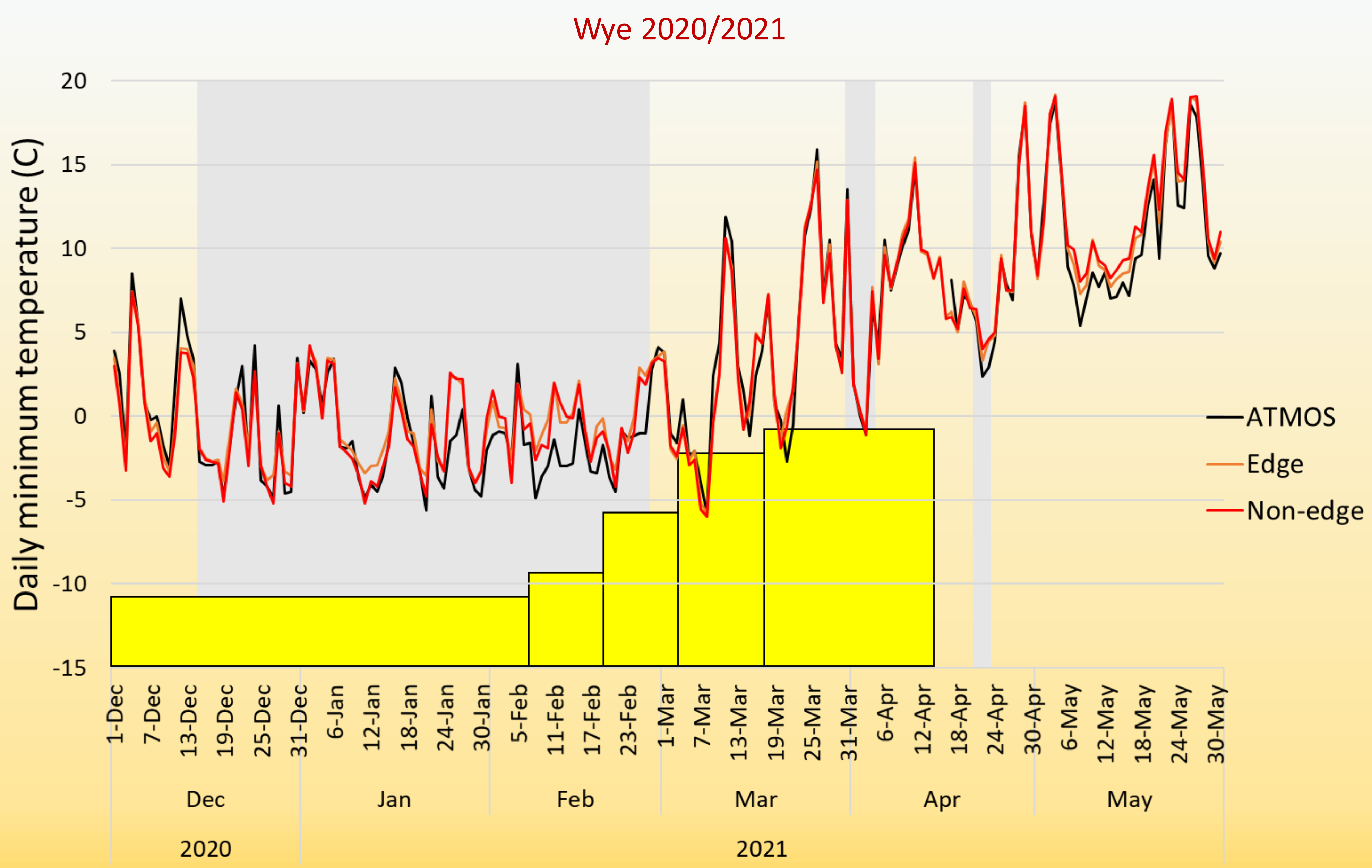
Minimum temperature often lower in the canopy



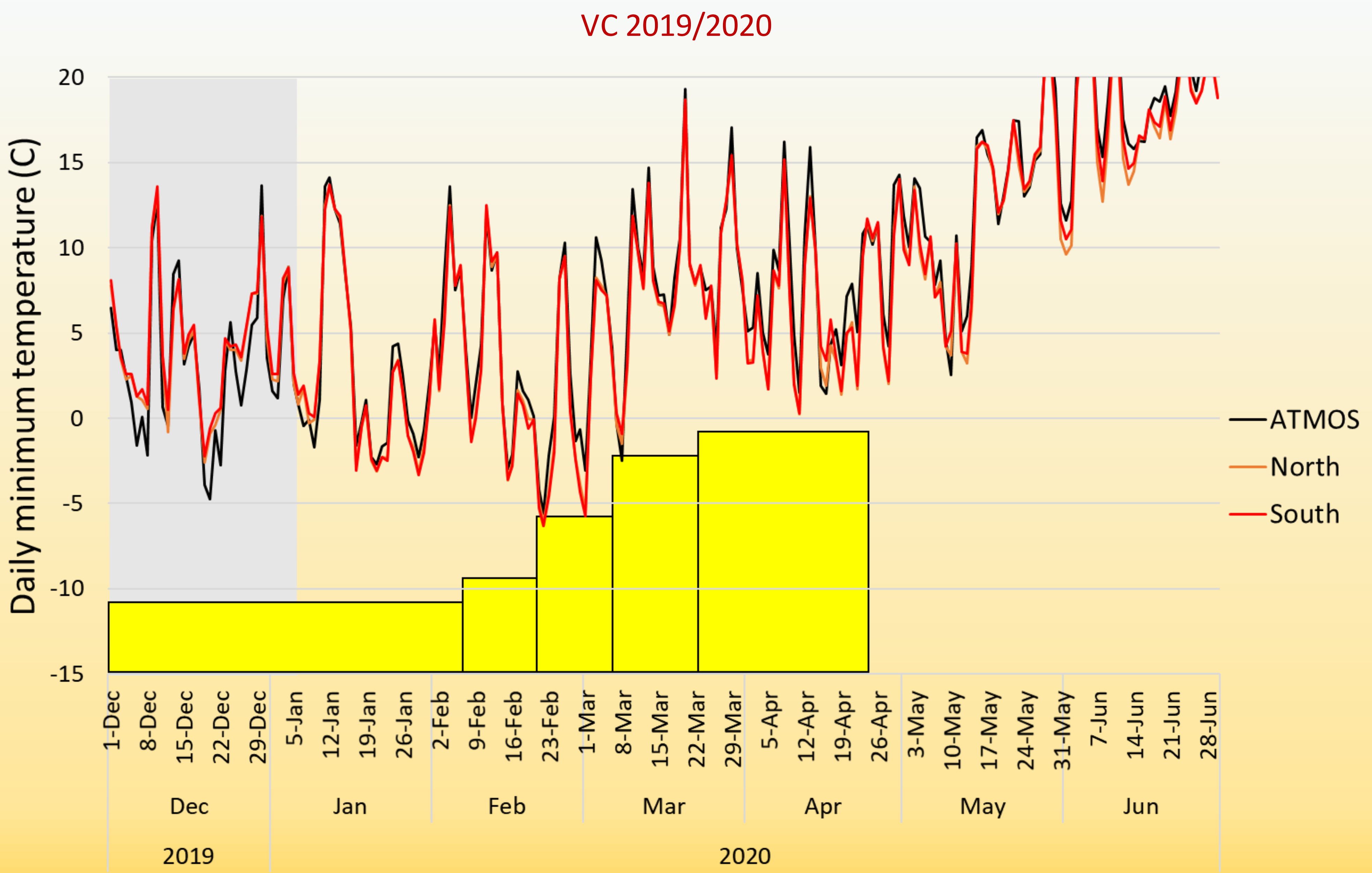
MB 2019/2020



Daily minimum temperature (C)
20
15
10
5
0
-5
-10
-15
1-Dec
7-Dec
13-Dec
19-Dec
25-Dec
31-Dec
6-Jan
12-Jan
18-Jan
24-Jan
30-Jan
5-Feb
11-Feb
17-Feb
23-Feb
29-Feb
6-Mar
12-Mar
18-Mar
24-Mar
30-Mar
5-Apr
11-Apr
17-Apr
23-Apr
29-Apr
5-May
11-May
17-May
23-May
29-May
4-Jun
10-Jun
16-Jun
22-Jun
Dec
Jan
Feb
Mar
Apr
May
Jun
2019
2020
ATMOS
Edge
Non-edge

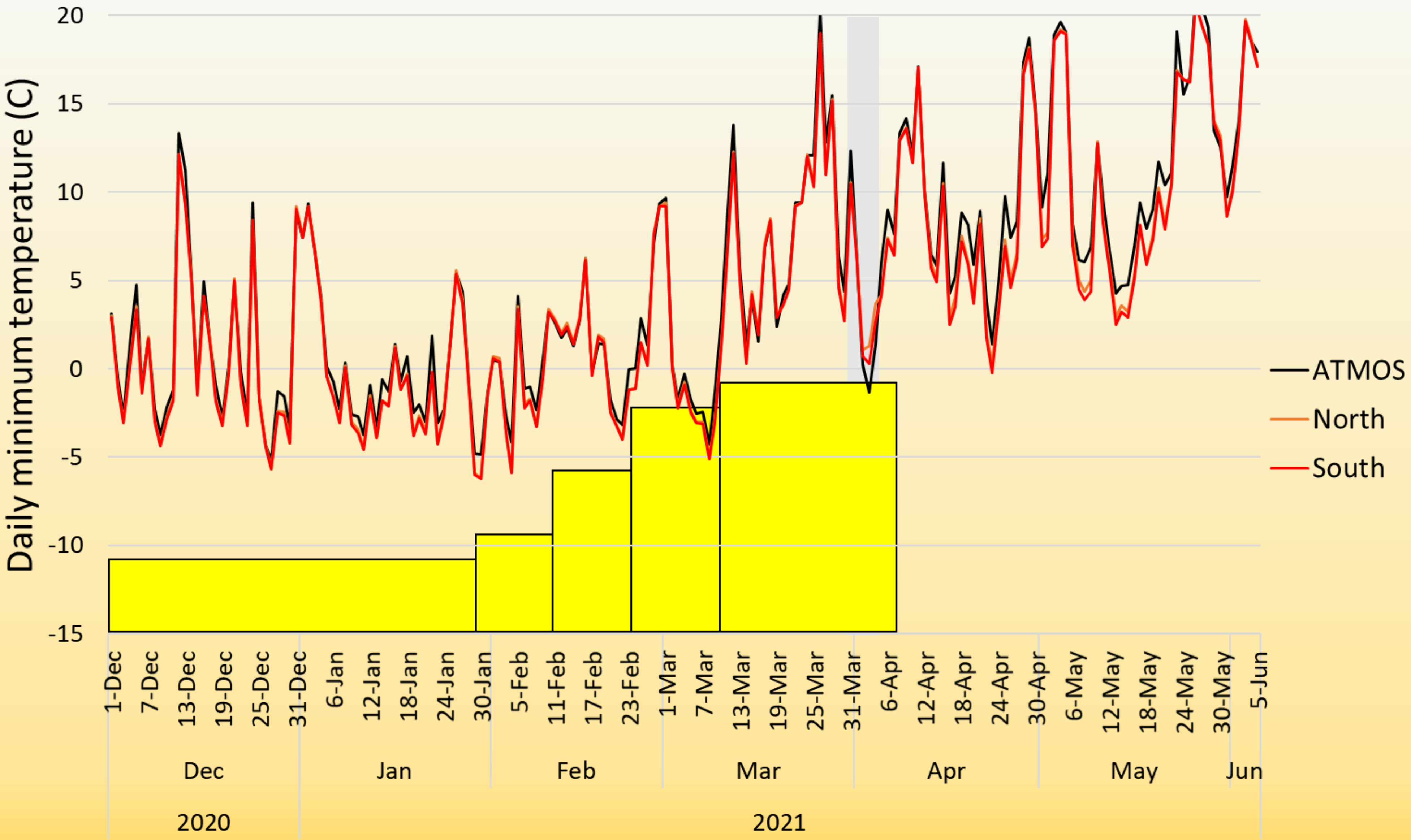


Wye 2020/2021
Daily minimum temperature (C)
20
15
10
5
0
-5
-10
-15
1-Dec
7-Dec
13-Dec
19-Dec
25-Dec
31-Dec
6-Jan
12-Jan
18-Jan
24-Jan
30-Jan
5-Feb
11-Feb
17-Feb
23-Feb
1-Mar
7-Mar
13-Mar
19-Mar
25-Mar
31-Mar
6-Apr
12-Apr
18-Apr
24-Apr
30-Apr
6-May
12-May
18-May
24-May
30-May
Dec
Jan
Feb
Mar
Apr
May
2020
2021
ATMOS
Edge
Non-edge



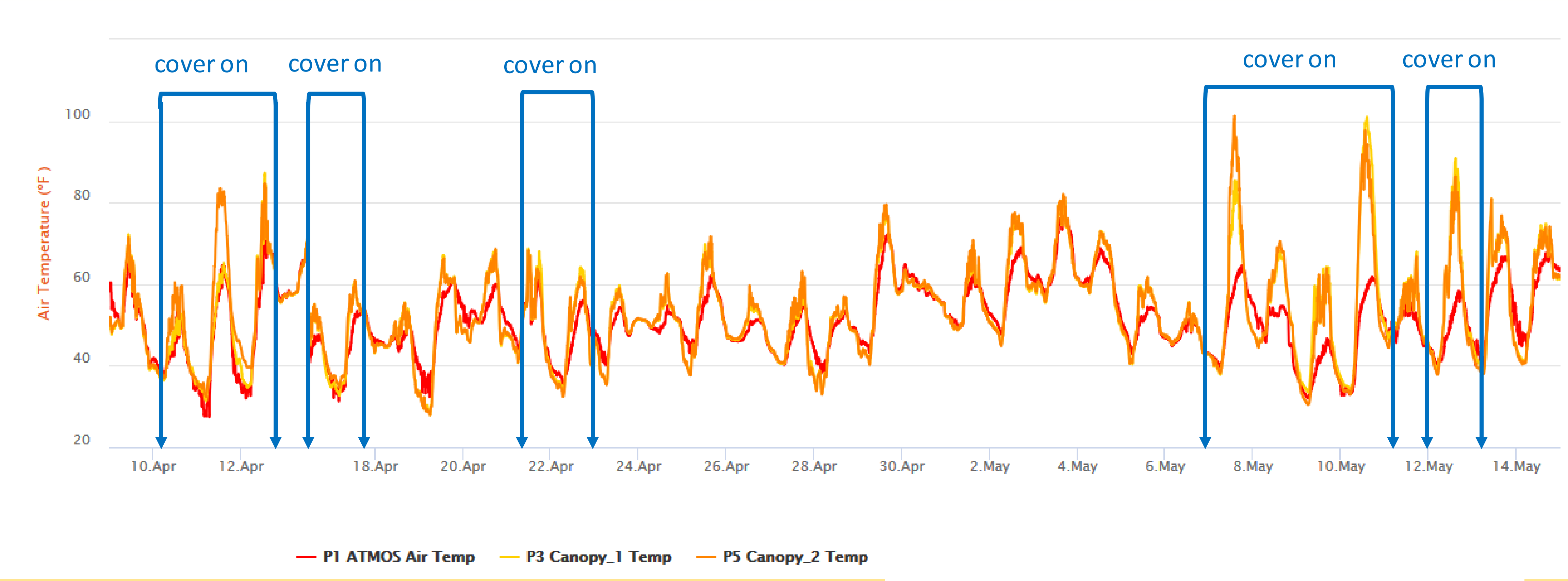
VC 2019/2020
Daily minimum temperature (C)
20
15
10
5
0
-5
-10
-15
ATMOS
North
South
1-Dec
8-Dec
15-Dec
22-Dec
29-Dec
5-Jan
12-Jan
19-Jan
26-Jan
2-Feb
9-Feb
16-Feb
23-Feb
1-Mar
8-Mar
15-Mar
22-Mar
29-Mar
5-Apr
12-Apr
19-Apr
26-Apr
3-May
10-May
17-May
24-May
31-May
7-Jun
14-Jun
21-Jun
28-Jun
Dec
Jan
Feb
Mar
Apr
May
Jun
2019
2020

VV 2020/2021



Daily minimum temperature (C)
20
15
10
5
0
-5
-10
-15
1-Dec
7-Dec
13-Dec
19-Dec
25-Dec
31-Dec
6-Jan
12-Jan
18-Jan
24-Jan
30-Jan
5-Feb
11-Feb
17-Feb
23-Feb
1-Mar
7-Mar
13-Mar
19-Mar
25-Mar
31-Mar
6-Apr
12-Apr
18-Apr
24-Apr
30-Apr
6-May
12-May
18-May
24-May
30-May
5-Jun
Dec
Jan
Feb
Mar
Apr
May
Jun
2020
2021
ATMOS
North
South

Hot days under covers in spring!



Take-Home Messages: Environmental variables

Canopy-level microclimates:

- Average temperature largely the same as nearby weather stations, however, the canopy seems to get warmer as its size increases
- Longer leaf wetness (LWS) duration – regardless of canopy size
- Higher maximum and often lower minimum temperature
- Variability between canopy-level sensors in the same field
  - Interior rows are wetter, compared to exterior rows

Row covers:

- Increase canopy temperatures more during the day than at night time
- Do not seem to increase LWS

Questions

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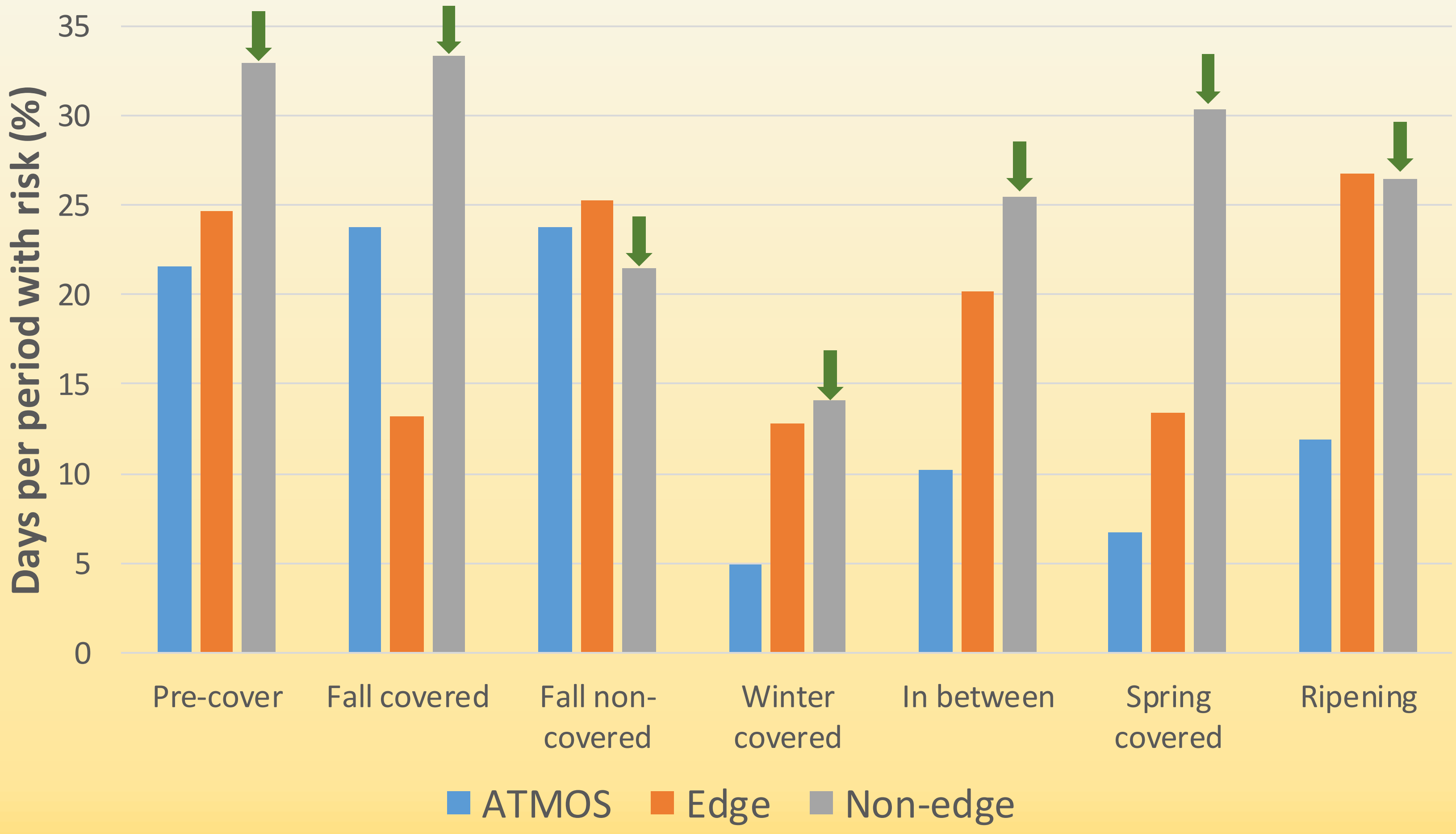
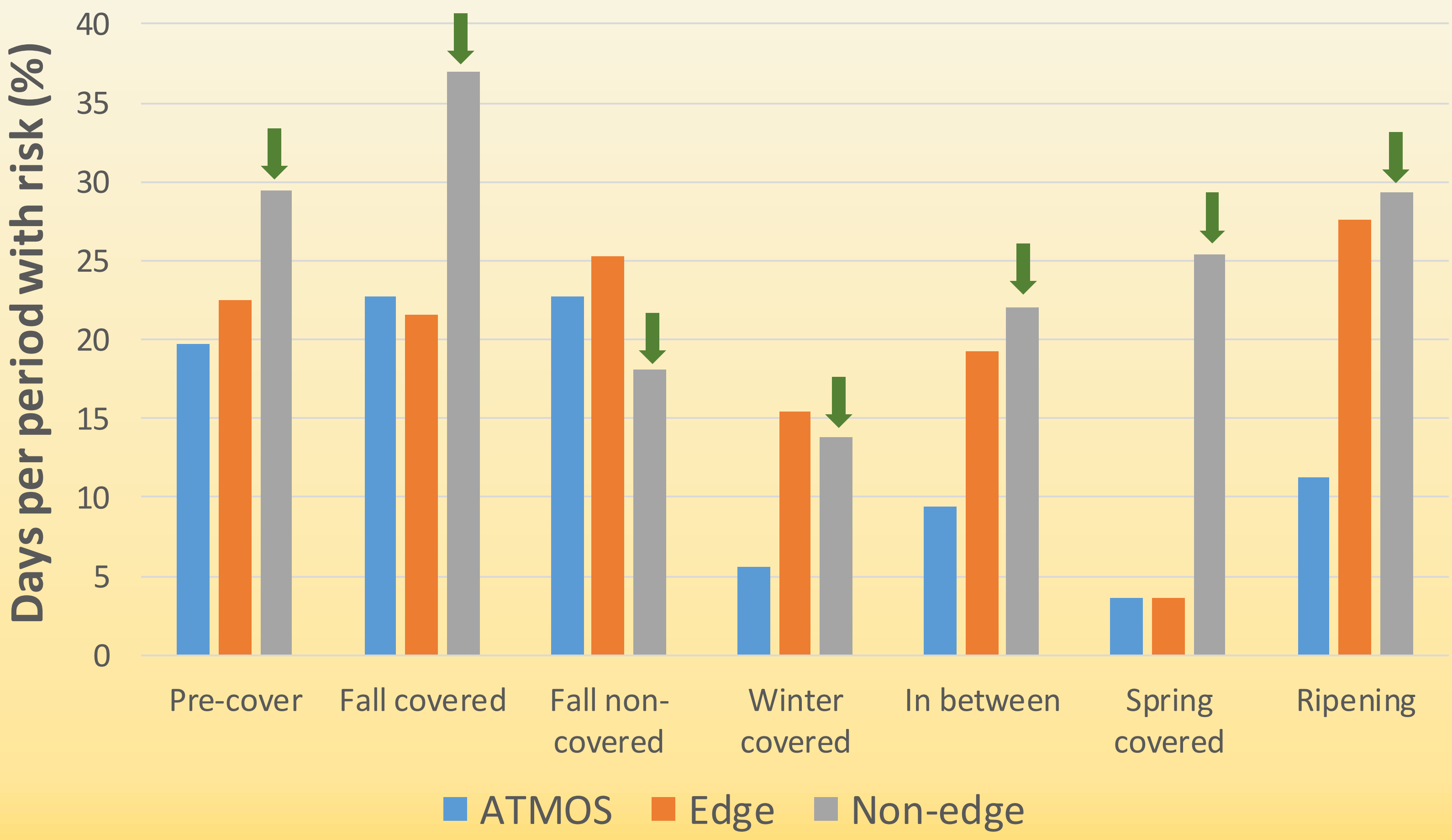
Average % BFR mod/high risk days



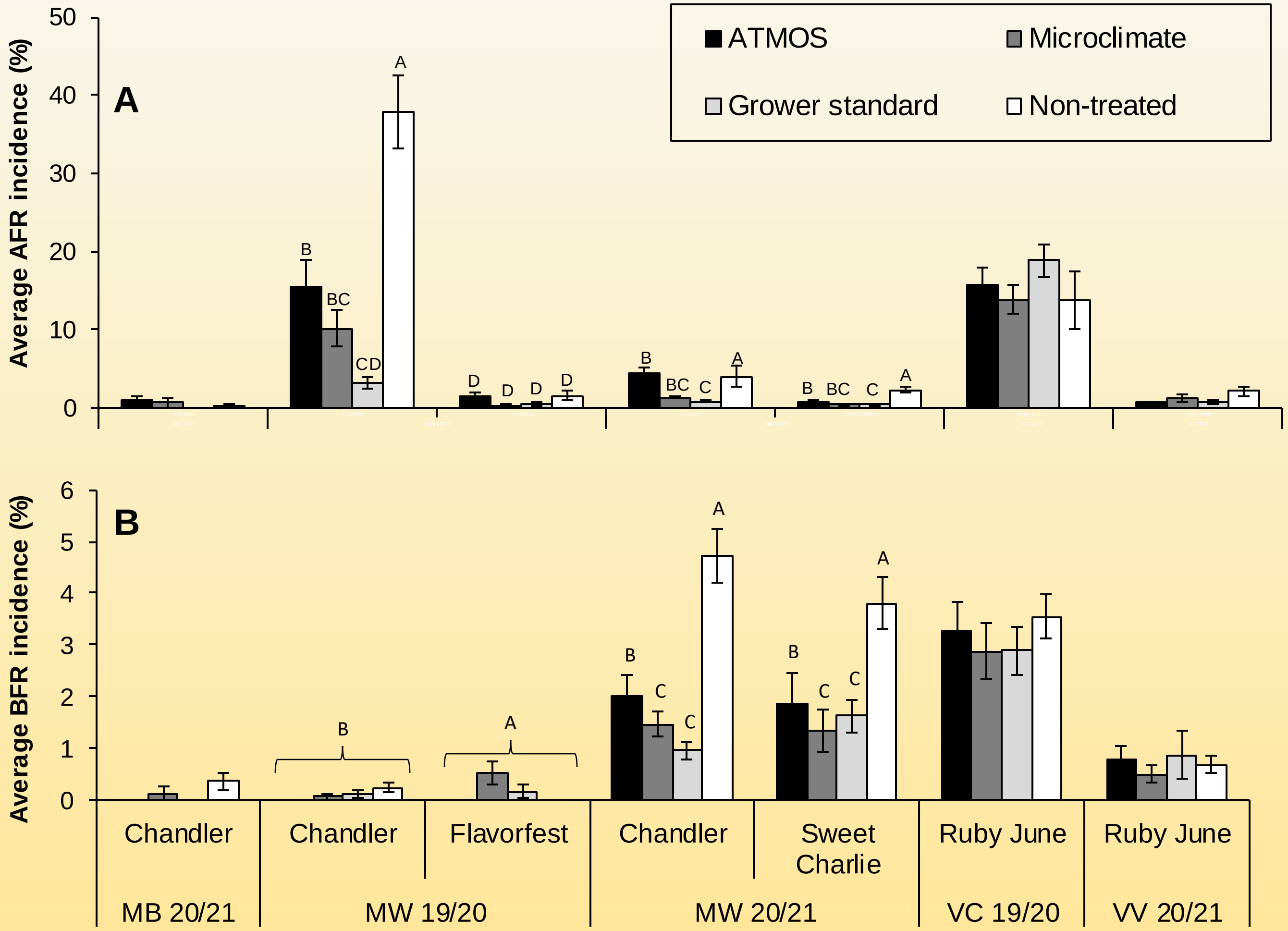
Average % AFR mod/high risk



Fungicide applications for weekly (grower standard) and model-based (ATMOS or microclimate) spray programs, and number of infection events

Season	Site	Fungicide applications: Grower standard	ATMOS	Microclimate	Reduction vs. weekly spray (%) (A/C)
2019-2020	MW	9	3	3	67 / 67
	MB	4	2	3	50 / 25
	VC	11	3	5	73 / 55
2020-2021	MW	7	1	4	86 / 43
	MB	4	3	3	25 / 25
	VV	9	3	4 [y]	67 / 56

Disease incidence



Take-Home Messages: Disease Management

Canopy-level microclimates:

- More infection days were predicted at the canopy
- Led to more fungicide applications compared to ATMOS
- May improve the efficacy of model-based spray programs

With row covers:

- Predicated disease risk was not changed during fall
- However, interior rows seemed to have higher infection risk compared to ATMOS or exterior rows

Increased Disease Risk Due to Longer Wetness at the Canopy-Level

Temp (F)	Leaf Wetness (hr) *	BFR		AFR	
		ATMOS	Canopy	ATMOS	Canopy
60	9	Low	Low	Low	Low
	12	Low	Moderate	Low	Low
	15	Low	High	Low	Moderate
65	9	Low	Low	Low	Moderate
	12	Low	Moderate	Moderate	Moderate
	15	Moderate	Moderate	Moderate	Moderate
70	9	Low	Low	Moderate	Moderate
	12	Low	Moderate	Moderate	Moderate
	15	Moderate	High	Moderate	High
75	9	Low	Low	Moderate	Moderate
	12	Low	Moderate	Moderate	High
	15	Moderate	High	High	High
80	9	Low	Low	Moderate	Moderate
	12	Low	Low	Moderate	High
	15	Low	Moderate	High	High
85	9	Low	Low	Moderate	Moderate
	12	Low	Low	Moderate	High
	15	Low	Low	High	High
90	9	Low	Low	Low	Moderate
	12	Low	Low	Moderate	Moderate
	15	Low	Low	Moderate	Moderate

*** According to ATMOS; Wet period is assumed 200 mins longer per day at the canopy**

Things to consider when adopting microclimate sensor system/disease models

- Not reducing disease severity/incidence, but would reduce sprays especially during drier years
- Sprays need to be made within 48 hrs (preferably 24 hrs)
- Interaction between cultivars and model-based sprays
- Instrument/sensor reliability, maintenance, and upgrade
- Capability of monitoring weather variables underneath row covers
  - ✓ Frost or freeze protection
  - ✓ Degree days calculation
  - ✓ Education – knowledge/experience gained

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Mr. Chris Cochran
Mr. Mike Newell
Grower cooperators

Partner:

Questions

Questions

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Land Acknowledgment

The Northeastern IPM Center is based at Cornell University in Ithaca, New York.

Cornell University is located on the traditional homelands of the Gayogo̱hó:nǫ' (the Cayuga Nation). The Gayogo̱hó:nǫ' are members of the Haudenosaunee Confederacy, an alliance of six sovereign Nations with a historic and contemporary presence on this land. The Confederacy precedes the establishment of Cornell University, New York state, and the United States of America. We acknowledge the painful history of Gayogo̱hó:nǫ' dispossession, and honor the ongoing connection of Gayogo̱hó:nǫ' people, past and present, to these lands and waters.

This land acknowledgment has been reviewed and approved by the traditional Gayogo̱hó:nǫ' leadership.

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