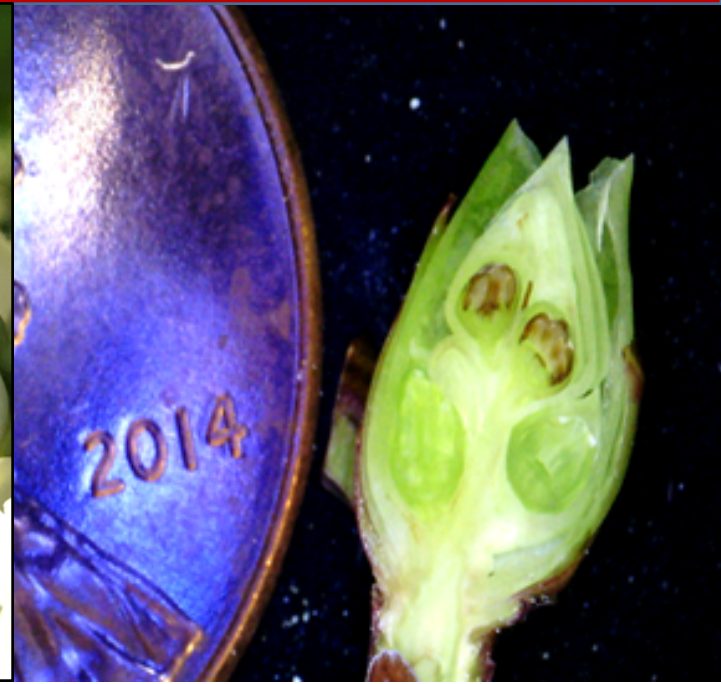


WSU Small Fruit Update: VacciniumCAP, Pollination, and Cold Hardiness



Lisa Wasko DeVetter
Assistant Professor of Horticulture
Washington State University

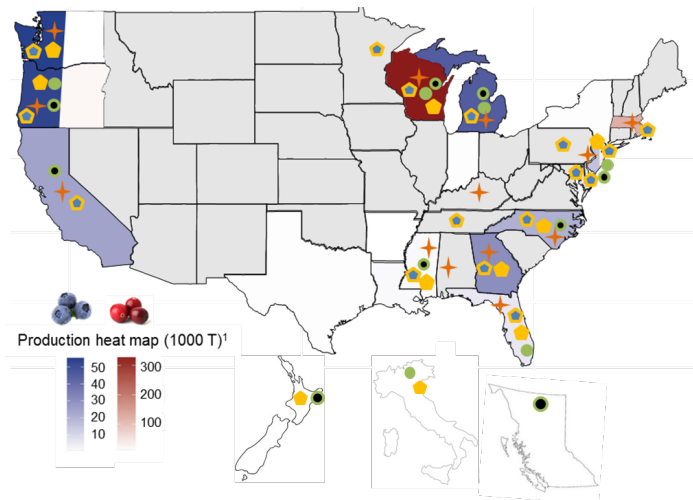
Small Fruit Horticulture Program



- Lead **state-wide** small fruit horticulture research and extension program
- Focus: **Whole-plant physiology** of small fruit crops in response to **alternative management** systems designed to **promote plant productivity**, **fruit quality**, **on-farm efficiencies**, and the health of adjacent natural resources
- Crops: **Red raspberry**, **blueberry**, and **strawberry**

VacciniumCAP:

**Leveraging Genetic and Genomic
Resources to Enable Development of
Blueberry and Cranberry Cultivars
with Improved Fruit Quality Attributes**



N. Vorsa
C. Soana



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UNIVERSITY
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FONDAZIONE
EDMUND MACH

L. Giongo



Michael Coe

Breeding Traits Survey

Distributed 2016-2017

Survey questions:

1-7. Traits - Fruit quality (10)

Disease resistance (18)

Pest resistance (16)

Stress tolerance (5)

Other traits (4)

Plant architecture for machine harvestability (8)

Most important traits (6)

8-13. Demographics – Profession

Farm size

Years of experience

Cultivars in production

Cultivars re-planted

Farm-business location



United States Department of Agriculture
National Institute of Food and Agriculture
Award #: 2016-51181-25401

13 grower assoc. meetings

Cranberry: 3 states

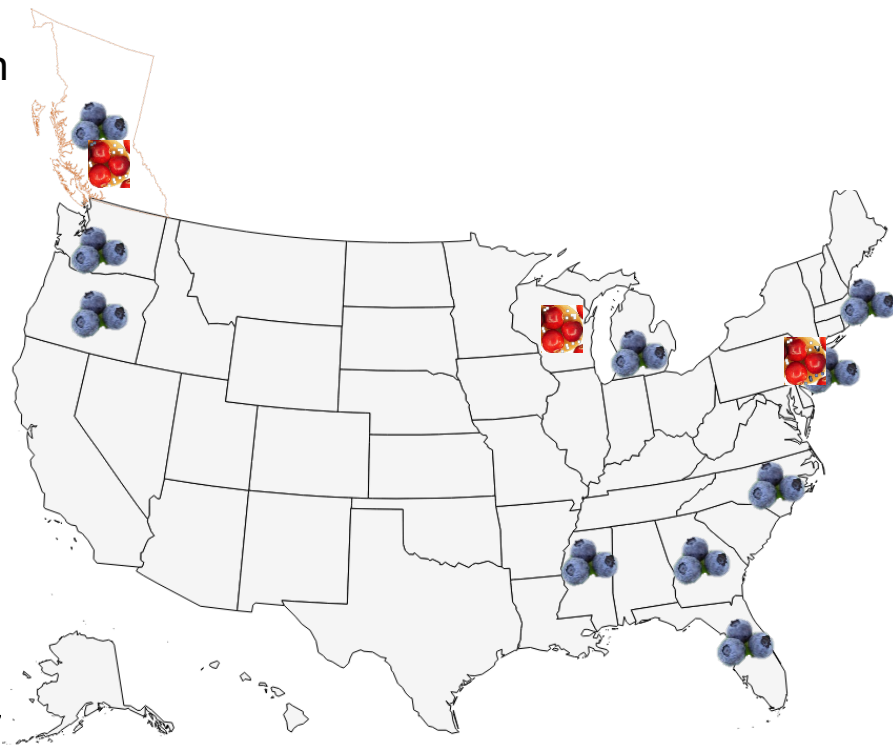
Blueberry: 10 states

Target stakeholders:

- Growers
- Nurseries
- Processors/packing houses
- Breeders
- Scientists

Meetings:

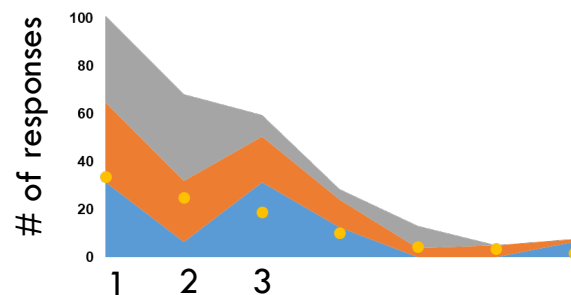
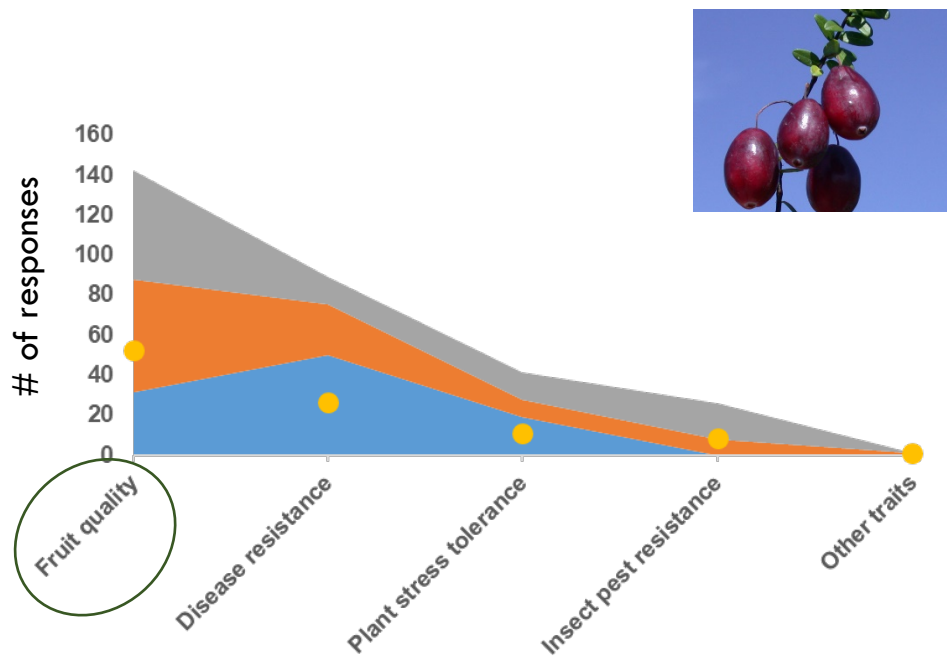
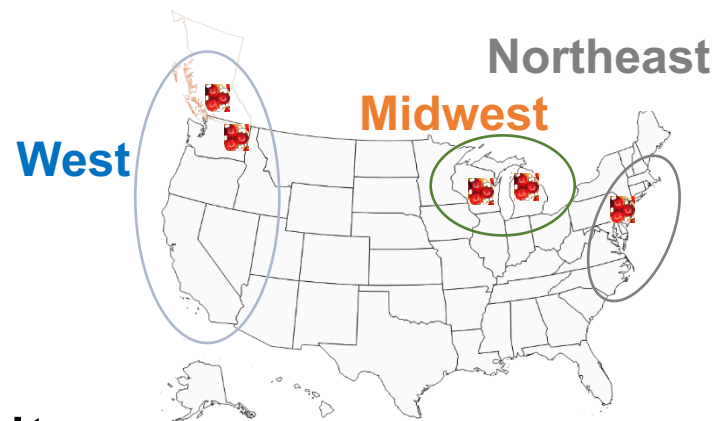
- 1) Massachusetts Blueberry Growers Association Meeting (MA)
- 2) Cranberry School (WI)
- 3) American Cranberry Growers Association Winter Meeting (NJ)
- 4) Blueberry Open House (NJ)
- 5) Alma Blueberry Update (GA)
- 6) Florida Blueberry Growers Association Spring Meeting and Trade Show (FL)
- 7) Oregon Blueberry Conference (OR)
- 8) Lynden Small Fruit Conference (WA)
- 9) Lower Mainland Horticultural Improvement Association Short Course (BC, Canada)
- 10) Blueberry Open House and Trade Show (NC)
- 11) Great Lakes Expo (MI)
- 12) Cape Cod Cranberry Growers Association Meeting (MA)
- 13) Gulf South Blueberry Growers Association Meeting (MS)



>500 respondents

- Growers (>80%)
- Nurseries
- Processers/packing houses
- Breeders/scientists

Fruit quality is a top breeding priority



- 1- Firmness
- 2- Fruit size
- 3- Anthocyanin content

Fruit quality is a top breeding priority

HORTSCIENCE 53(10):1467–1474. 2018. <https://doi.org/10.21273/HORTSCI13219-18>

Breeding Trait Priorities of the Cranberry Industry in the United States and Canada

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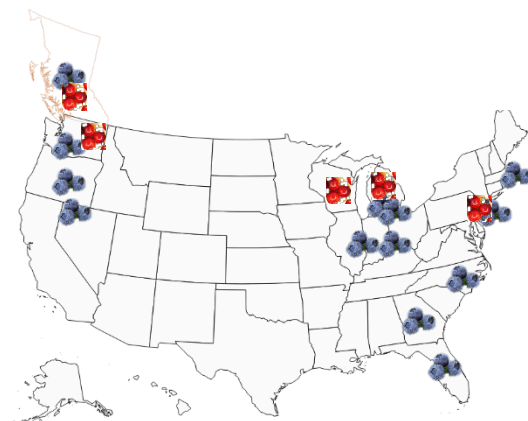
USDA-ARS, Vegetable Crops Breeding Unit, Department of Horticulture, University of Wisconsin-Madison, 1575 Linden Drive, Madison, WI 53706

Cesar Rodriguez-Saona and Nicholi Vorsa

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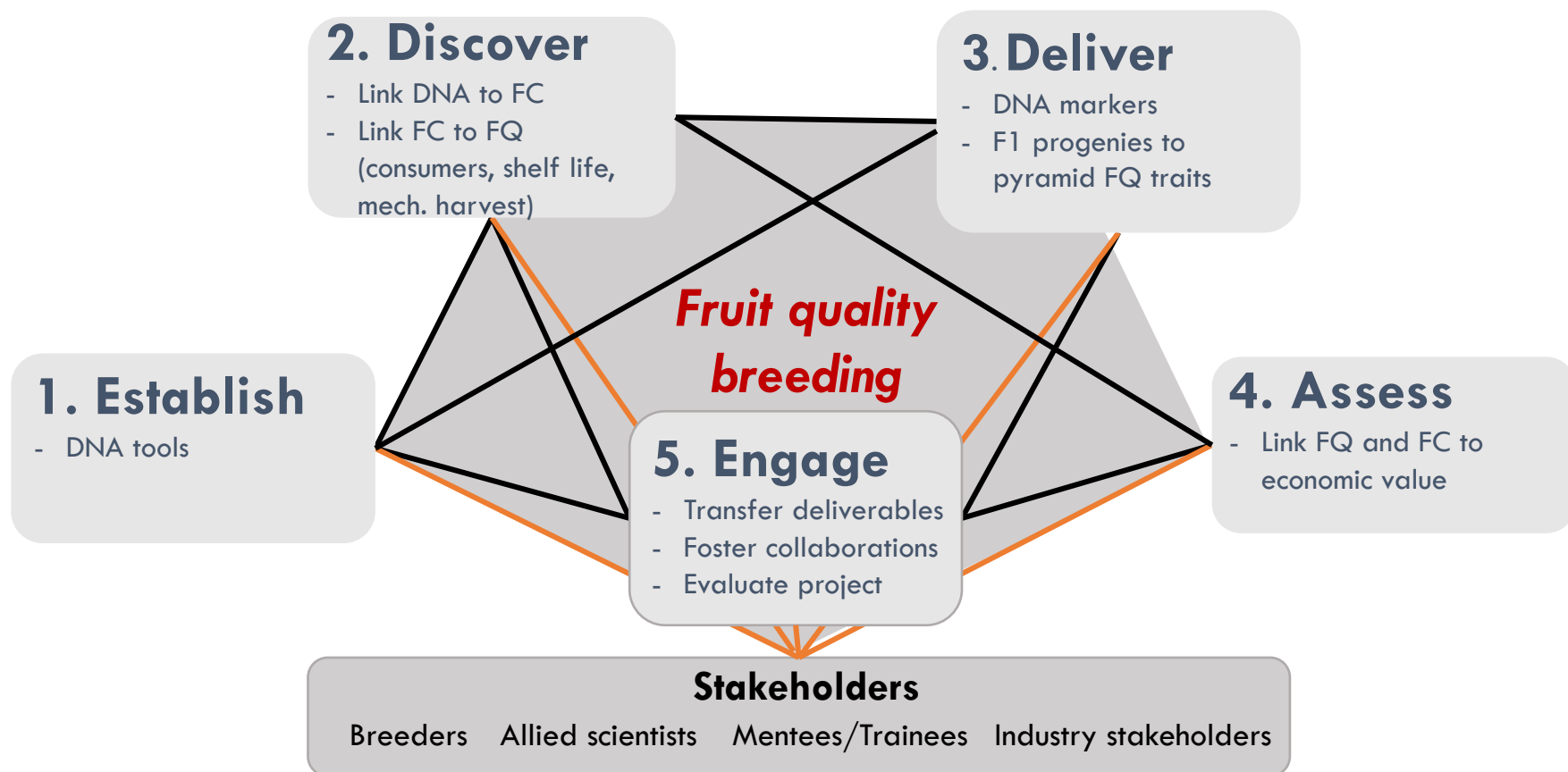
Fruit characteristics (FC)

- *Texture*
- *Appearance*
- *Chemical composition*

Link

Fruit quality (FQ)

- *Consumer preferences*
- *Shelf life*
- *Mechanical harvestability*



Thank You





Determining Cold Hardiness in Washington Blueberry



Gwen Hoheisel, Lisa DeVetter, Lav Khot, and David Gibeaut



WASHINGTON BLUEBERRY COMMISSION
Serving the Blueberry Industry of Washington

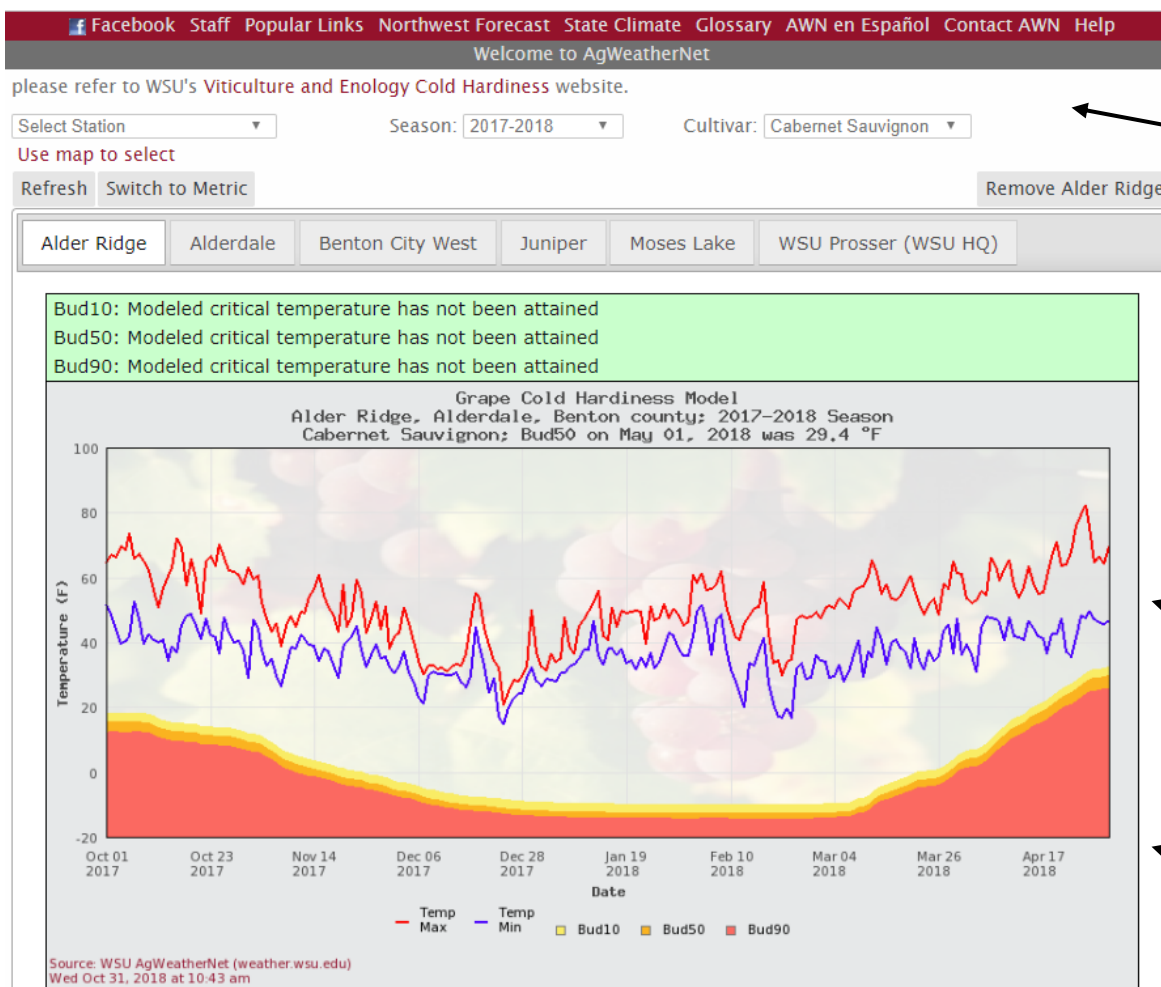


Prosser
IAREC



Overarching Objectives:

Develop Predictive Cold Hardiness Models for Several Blueberry Cultivars

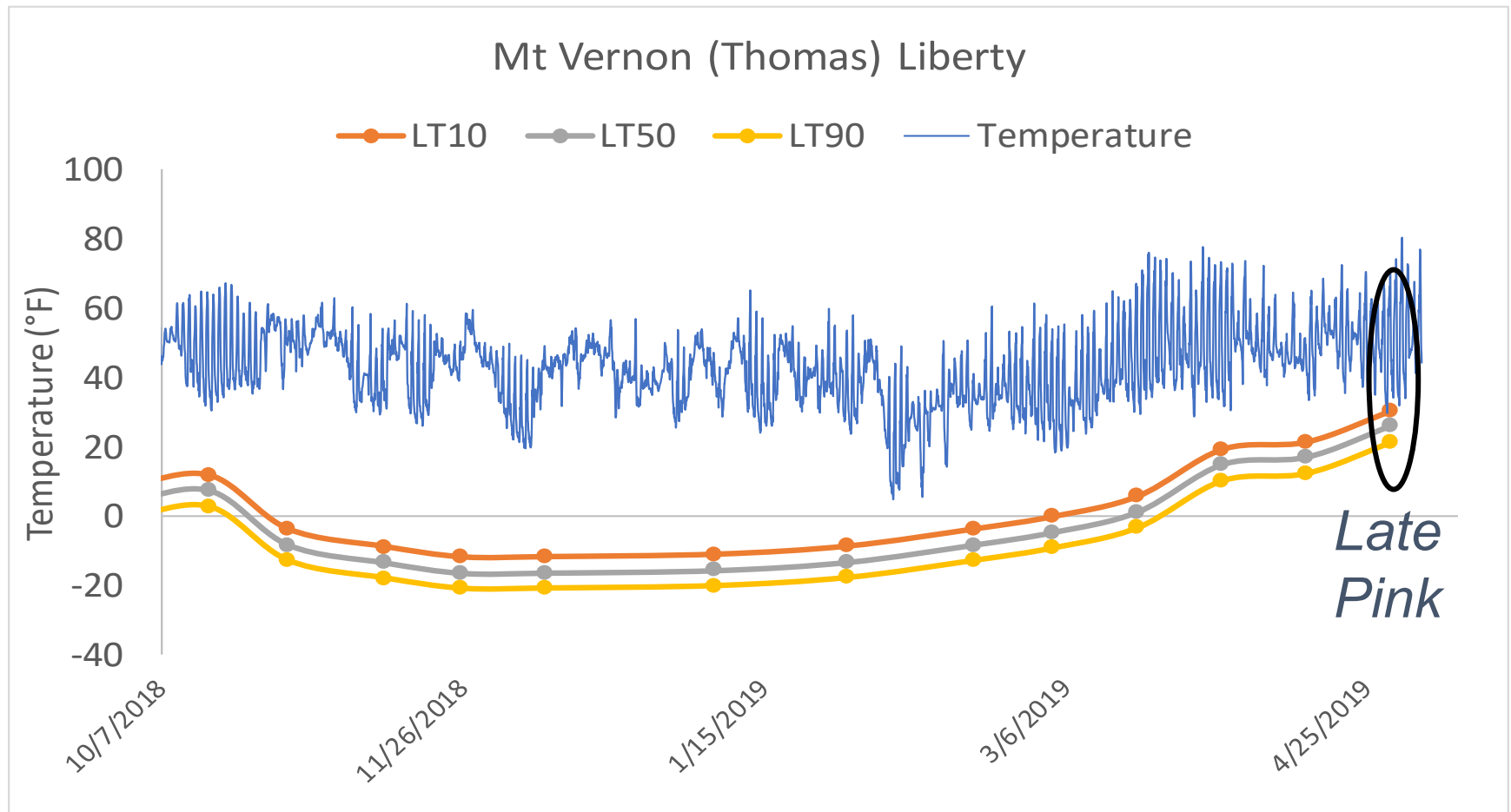


AWN station,
year, cultivar

Max and Min
Temperatures

Hardiness
Temperature

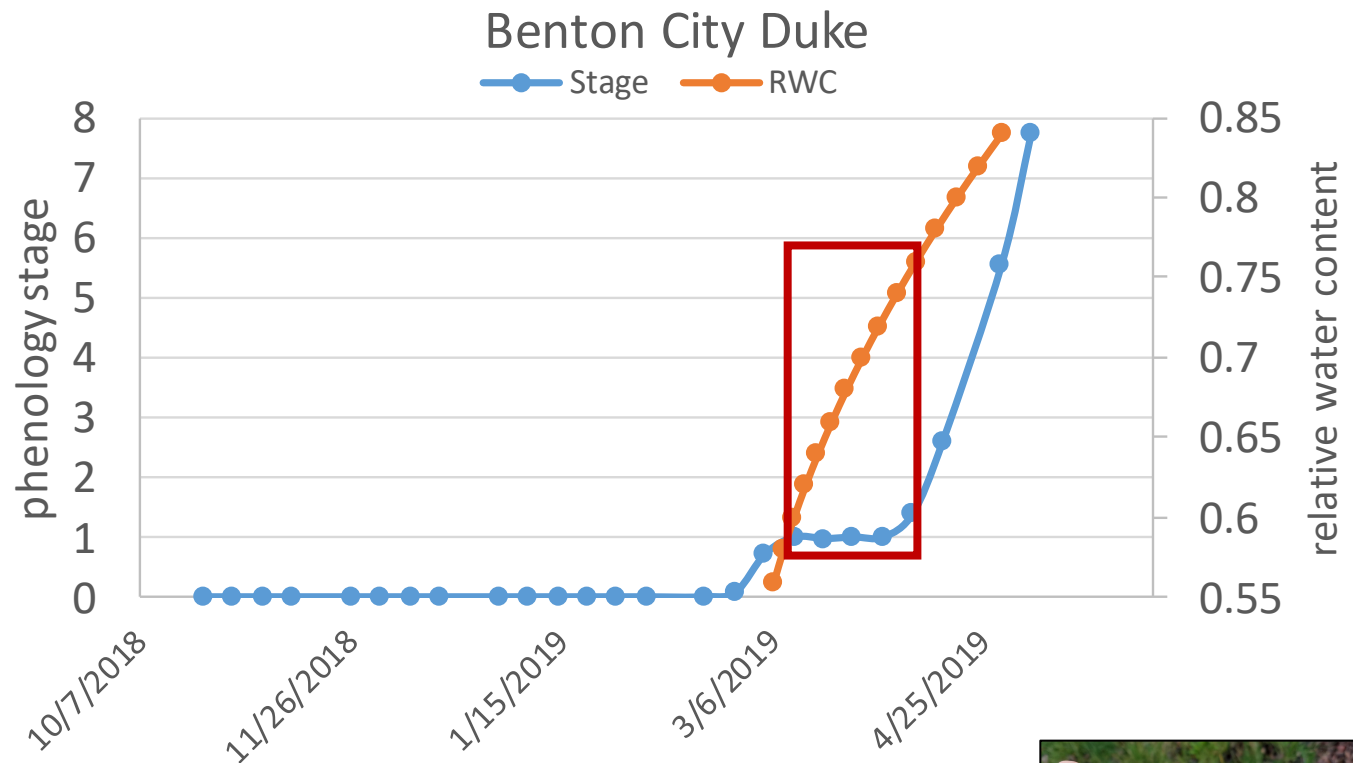
Blueberry Cold Hardiness Model undergoing Beta Testing in 2020



Can Relative Water Content (RWC) in Buds Predict Hardiness?

Stage

- 8 - Petal Fall
- 7 - Full bloom
- 6 - Early bloom
- 5 - Late pink
- 4 - Early pink
- 3 - Tight cluster
- 2 - Bud break
- 1 - Bud swell
- 0 - Dormant



- Water content affects cold hardiness
- Lots of water gained at bud swell
- RWC could allow rapid estimates of hardiness



Increased Hive Densities Promote Honey Bee Pollination in Blueberry



Lisa Wasko DeVetter
Students: Weixin Gan and Matt Arrington
Washington State University



Honey Bees are Important Pollinators



- Honey bees (*Apis mellifera ligustica*) pollinate over 130 crops, including blueberries and cranberries
- Weakness of *ligustica* includes **poor foraging** at **temperatures below 55 °F**, with **moderate winds** (≥ 12 mph), and with **precipitation** (Woyke et al., 2003)
- How do we **optimize** to ensure **good pollination**?

Revisiting Hive Stocking Densities



Invest in pollination for success with highbush blueberries

For profitable yields, investing in pollination of highbush blueberries is crucial.

Cultivar	Low rate	High rate
	Hives/acre	
Rubel, Rancocas	0.5	1
Weymouth, Bluetta, Bluray	1	2
Bluecrop	1.5	3
Elliot, Coville, Berkeley, Stanley	2	4
Jersey, Earliblue	2.5	5

- Having an adequate number of **healthy** honey bee hives is important in **intensive systems** with **high bloom density** and/or **low wild pollinator diversity and abundance**
- Hive density recommendations **may be outdated** or need to be **adapted for new systems**

Previous Studies in Washington...



- DeVetter et al. (2016) found honey bee visitation rates in western Washington were **below recommended guidelines**
- Studies suggests 'Duke' yield can be **increased** by ~2.65 lbs/plant by **increasing stocking densities** from 4 to 8 hives/acre (Arrington and DeVetter, 2018)



Objective

Evaluate the effects of increased honey bee hive density in 'Duke' and 'Draper' blueberry

Experiment 1 – Hive Density

Procedures

- Studies conducted in **Skagit** and **Whatcom** counties
- **15 sites total** in 2018 and 2019

Treatments – ‘Duke’

1. 3 fields, each with 4 hives/acre (control)
2. 3 fields, each with 8 hives/acre
3. 3 fields, each with 10 hives/acre

Treatments – ‘Draper’

1. 2 fields, each with 4 hives/acre (control)
2. 2 fields, each with 8 hives/acre
3. 2 fields, each with 10 hives/acre

‘Duke’ Stocked at 10 hives/acre



Results

Hive Density Experiment

‘Duke’

Density (hives/acre)	Visitation rate (honeybees/bush/minute)		Fruit set (%)	Berry mass (g/berry)	TSS	Seed no./berry
	2018	2019				
4	1.0 c ^z	1.5 c	79.4 b	1.7	12.5 b	40
8	1.4 b	2.8 b	74.5 b	1.8	13.5 ab	43
10	2.0 a	3.5 a	96.9 a	1.9	14.0 a	46
<i>Significance</i> ^y	<0.0001	<0.0001	<0.0001	0.19	0.04	0.56

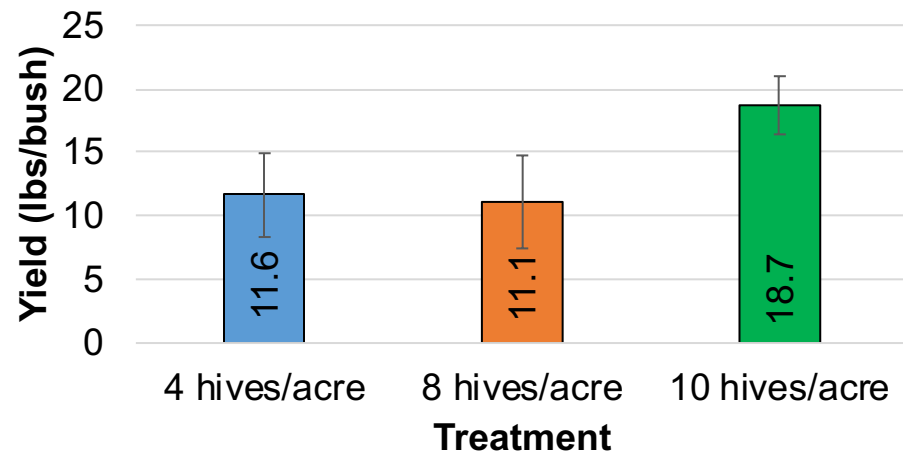
^zMeans separations were performed with and Tukey's Honest Significant Difference (HSD) test or non-parametric Wilcoxon test; means with the same letter are not different at $P \leq 0.05$.

^y P -value with significance at $\alpha = 0.05$.

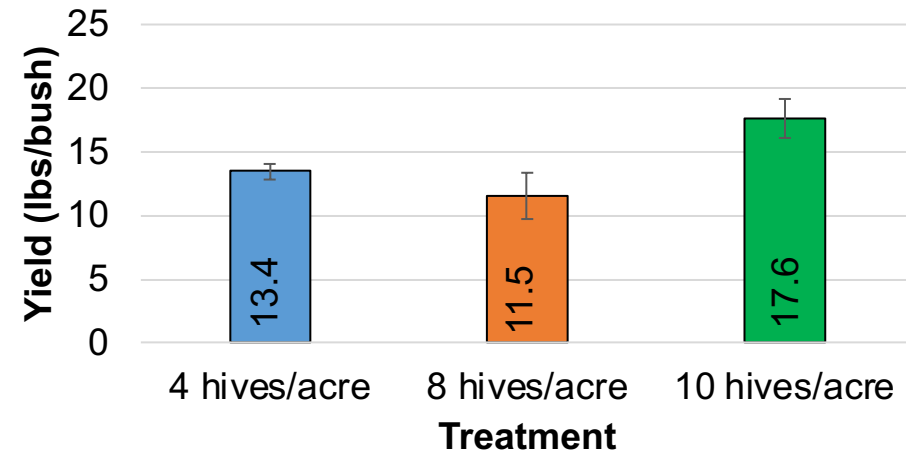
Results

Hive Density Experiment

'Duke' - 2018



'Duke' - 2019



No statistical effects on yield ($\alpha=0.05$), but trend of increasing yield at higher hive densities

Results

Hive Density Experiment

‘Draper’

Density (hives/acre)	Visitation rate (honey bees/bush/minute)		Fruit set (%)	Berry mass (g/berry)	TSS	Seed no./berry
	2018	2019				
4	0.7 c ^z	1.2 b	67.5 b	2.2	17.6	24
8	1.4 b	1.0 c	73.4 b	2.4	16.1	33
10	1.6 a	1.7 a	87.6 a	2.4	16.3	32
<i>Significance</i> ^y	<0.0001	<0.0001	<0.0001	0.12	0.09	0.16

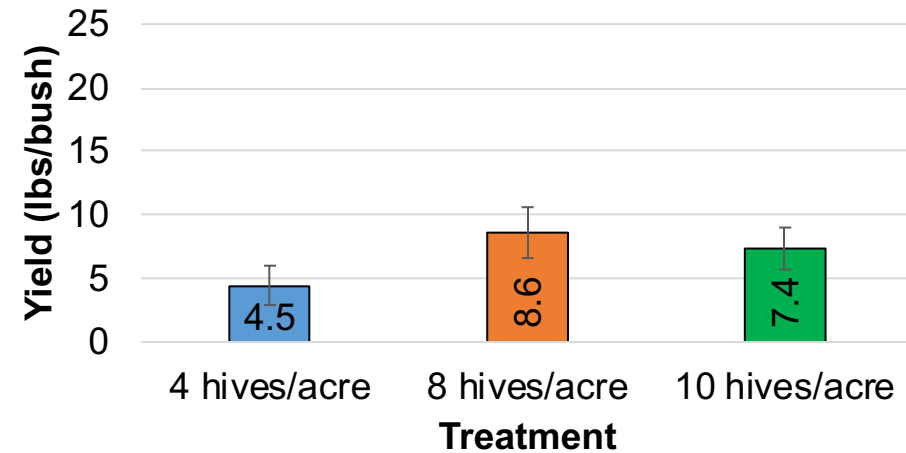
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^y P -value with significance at $\alpha = 0.05$.

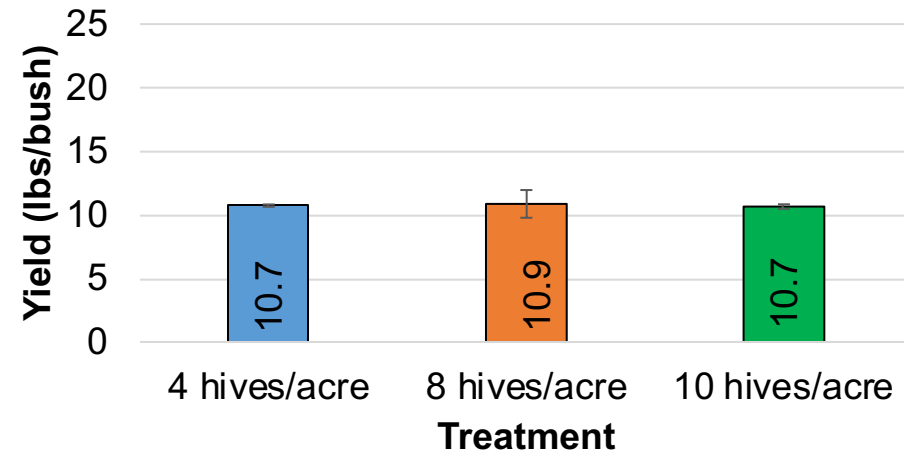
Results

Hive Density Experiment

'Draper' - 2018



'Draper' - 2019



No statistical effects on yield ($\alpha=0.05$)

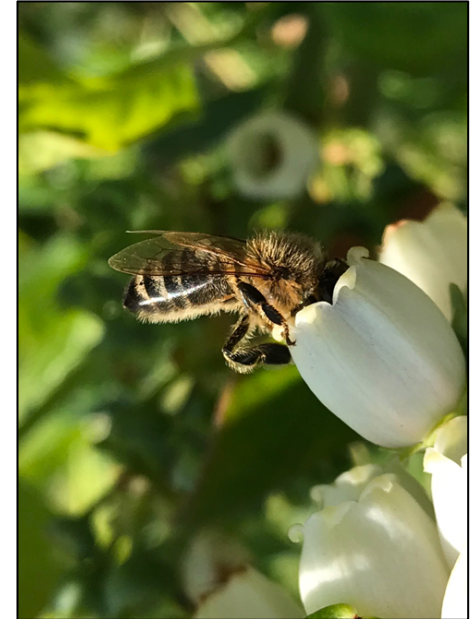


'Draper' Drop



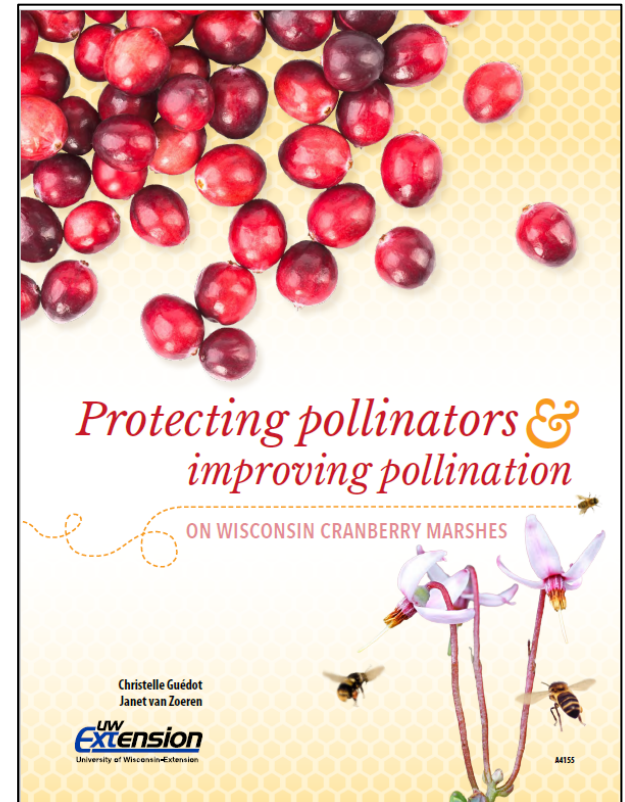
Conclusions to Date

- Continuing to observe **positive trend** for increasing hive density in 'Duke' (but not 'Draper')
- Increasing hive density doesn't fix **other management problems** or **poor hive quality**
- Encourage growers to **test different hive densities** in **small blocks**
- Commercial **pheromones** **marginally impact honey bee activity** and **do not improve yield components**



Pollination for Cranberry

- Honey bee hive densities range **2-3 hives/acre**
- ~20-30% of pollination by **wild bees**
- If pollination and fruit set are low, consider increasing **wild pollinator habitat** or **honey bee hive densities**
- **Flower morphology** can limit honey bee pollination
- Pollinator habitat may lead to **competing forage sources**
- Future of ***Bombus vosnesenskii***



Acknowledgements

Project Assistance

- Grower cooperators
- Sean Watkinson, Huan Zhang, and Nadia Bostan
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- Jason Meyer
- Tom Peerbolt
- Kennedy Grant
- Kurtis Plaisted @ Grigg Honey
- Bellevue Bees

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- Washington Blueberry Commission
- Northwest Agricultural Research Foundation (NARF)



Thank you! Any Questions?

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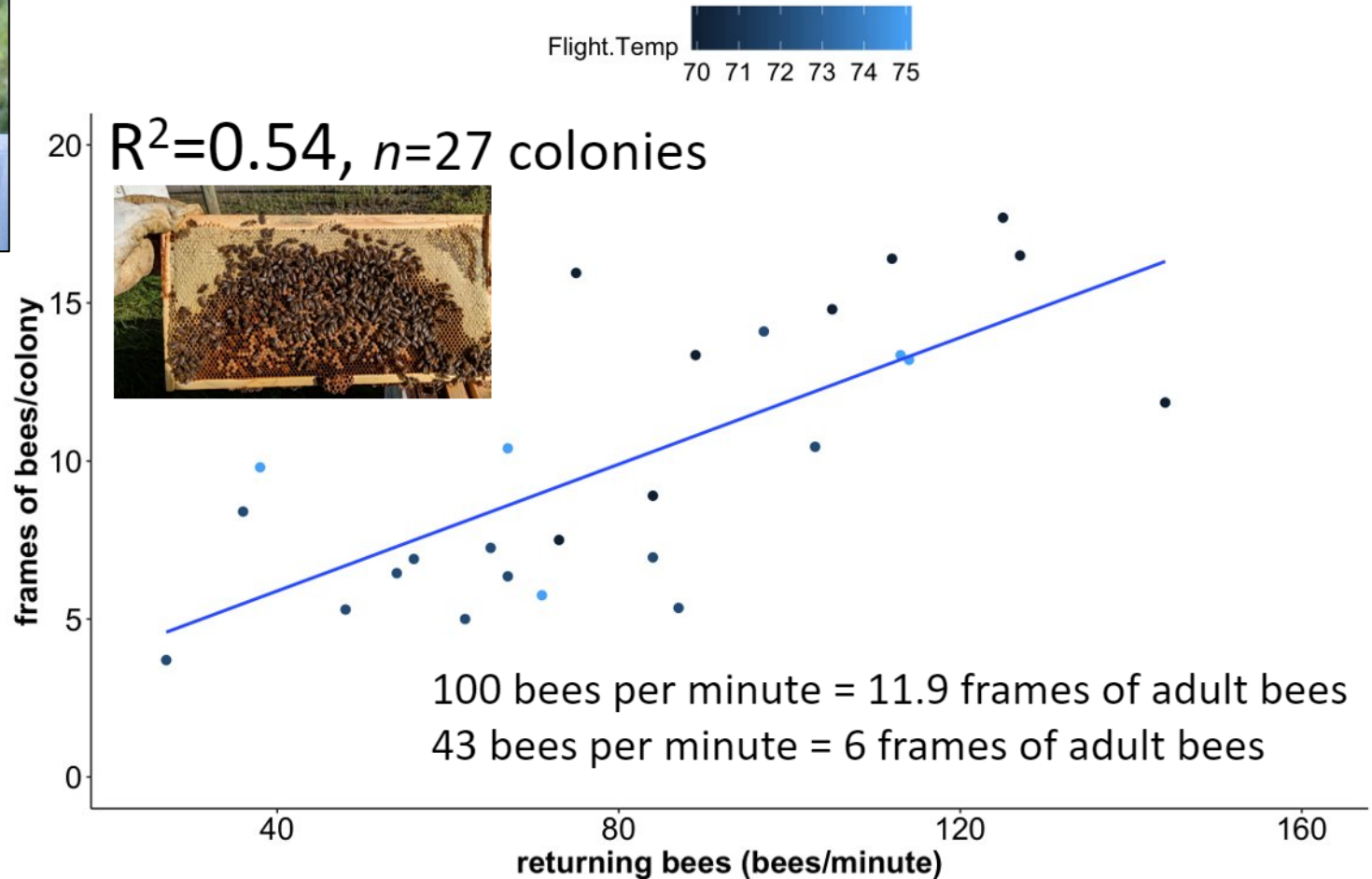
Data Collection

Hive Density and Pheromone Experiments

- Measured **pollinator activity**, as described by Courcelles et al. (2013)
 - Measured activity at 15-100% bloom
 - 9:30 AM to 4 PM; ≥ 55 °F
 - N = 30 bushes/ site, measured three times/day for three days over bloom
 - Only counted “**legitimate**” visits
- Other variables – **fruit set**, **berry mass**, **seed number/berry** (Strik et al., unpublished), **average yield per bush**, **quality**



Frames of Brood is Related to Activity



Data courtesy of Andony Melathopoulos @