



# Black Raspberry Breeding Update



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# Background & Introduction

Black raspberries (*Rubus occidentalis*, a.k.a. ‘blackcaps’) are a perennial crop native to North America, with a long history of production dating back to the 1900’s (Jennings 1988)



Native range of black raspberry (*Rubus occidentalis*). Stars indicate research sites. (PLANTS database)



# Background & Introduction

## US Black Raspberry Production 2014 (USDA):



- 1650 acres; 4760 lbs/acre
- Farm gate value: **\$16.8M**
  - 98% processing market
- Most acreage is ‘Munger’, developed in OH in 1897

(Dossett 2012)





# Background & Introduction

- The black raspberry industry in the US has been stagnant for ~75 years
- Breeding progress has been hindered by:
  - Low diversity
  - No disease resistance



ars.usda.gov

(Halgren et.al 2007)



# Background & Introduction

- Health benefits of black raspberries has led to a renewal of breeding efforts (Espin et.al. 2007)
- Black raspberry whole-berry products have been shown as chemopreventative agents for certain cancers (Rao & Snyder 2010)



# Developing the genomic infrastructure for black raspberries breeding improvement:

## Focus Areas:

1. Plant Breeding
2. Molecular Biology
3. Genomics
4. Analytical Chemistry
5. Product Evaluation
6. Communication & Marketing



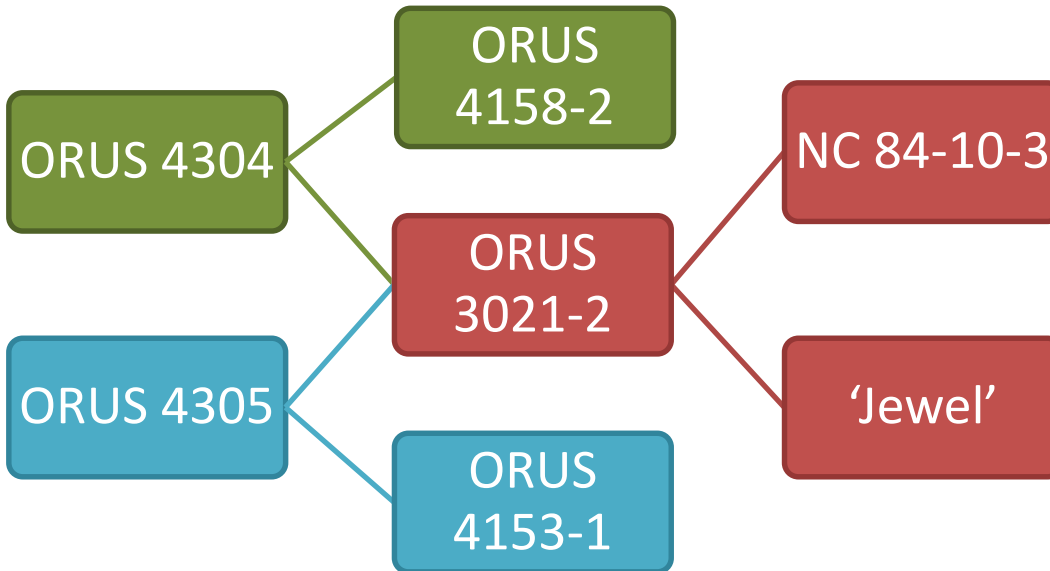


# Plant Background

Wild source of aphid resistance from Maine

Wild accession collected for heat and fungal disease resistance from Piedmont-Coastal Plain of North Carolina

Population 1  
– 192 Plants



Wild source of aphid resistance from Ontario

Population 2  
– 115 Plants



# Research Sites



North Carolina  
35.2°, -79.7°;  
elevation 191m



Oregon  
44.5°, -123.3°;  
elevation 72m





Scoring criteria for traits of interest

Trait	Proposed Selection Criteria	Range	Mean
Aphid	Susceptible (S) or Resistant (R)	S / R	-
Berry weight	> 2.2 grams per berry	0.2 – 3.1g	1.5g
Ease of Picking	≥ 4 (1-5 scale)	1 – 5	3.5
Flavor	≥ 6 (1-9 scale) – sugar/acid balance	3 – 9	5.9
Vigor	≥ 7 (1-9 scale), measured at flowering	2 – 9	6.6
Fruit Firmness	≥ 6 (1-9 scale)	4 – 9	6.2
Fruit Set	≥ 8 (1-9 scale), measured after pollination	1 – 9	7.6
Lateral Length	> 25 cm (10 inches)	3.6 – 15.3 cm	9.4 cm
Seediness	< 0.07mg/g, measured on 25 berry sample	0.03 – 0.2 mg/g	0.09 mg/g
Yield	> 2.5 kg ( 5.5 lbs) per plant	0 – 4.4 kg	1.4 kg



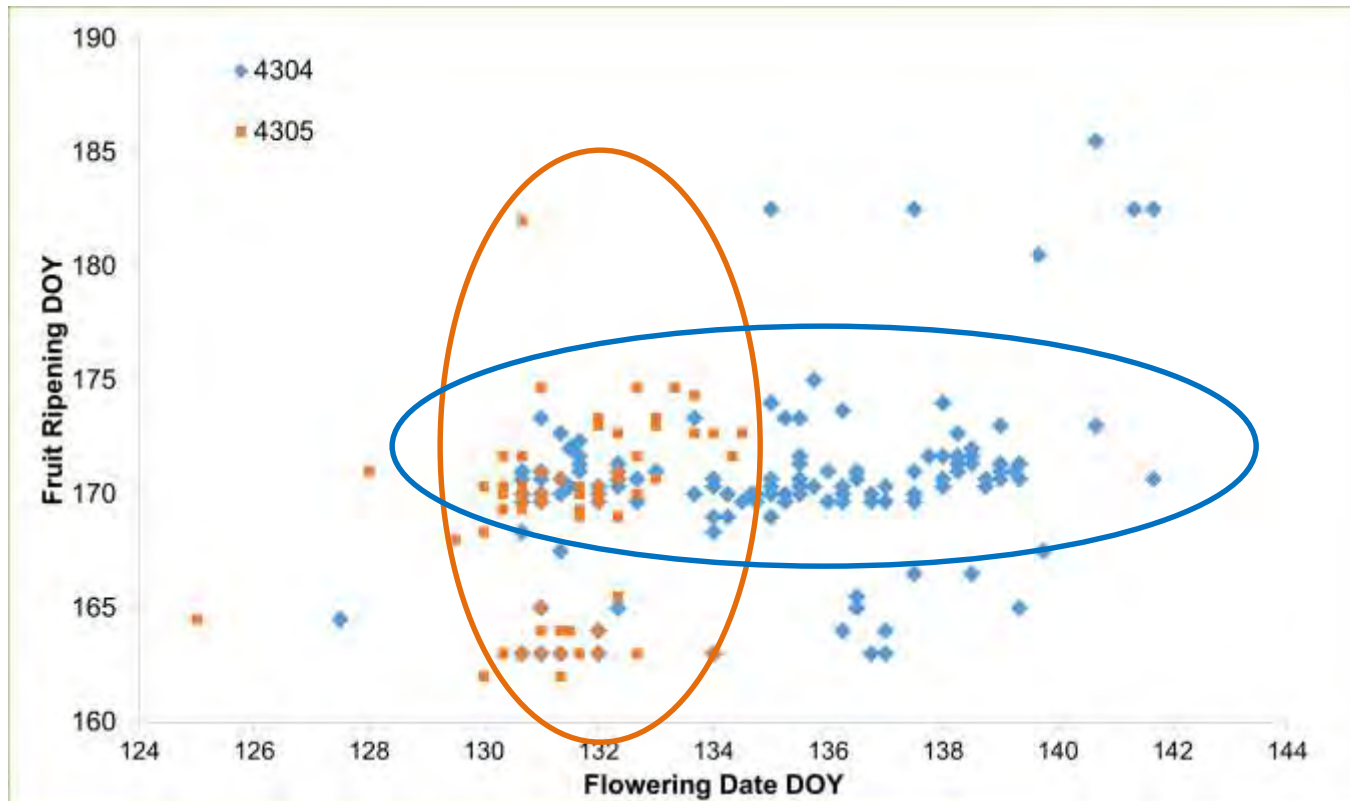
# Results

State x	NC	OR	OH	NY	<i>p</i> -value
Flowering Date	126	130	143	147	<0.0001
Ripening Date	153	166	180	184	<0.0001
Ripening Interval	27*	37	36	36	na

Flowering and fruit ripening dates were different at each location. North Carolina had the shortest interval between flowering and fruiting



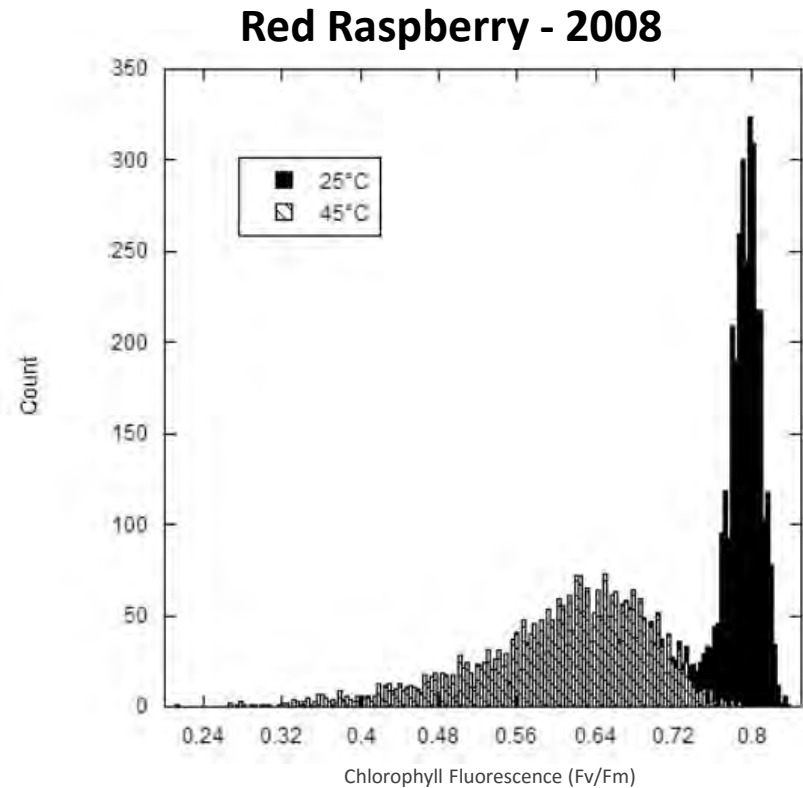
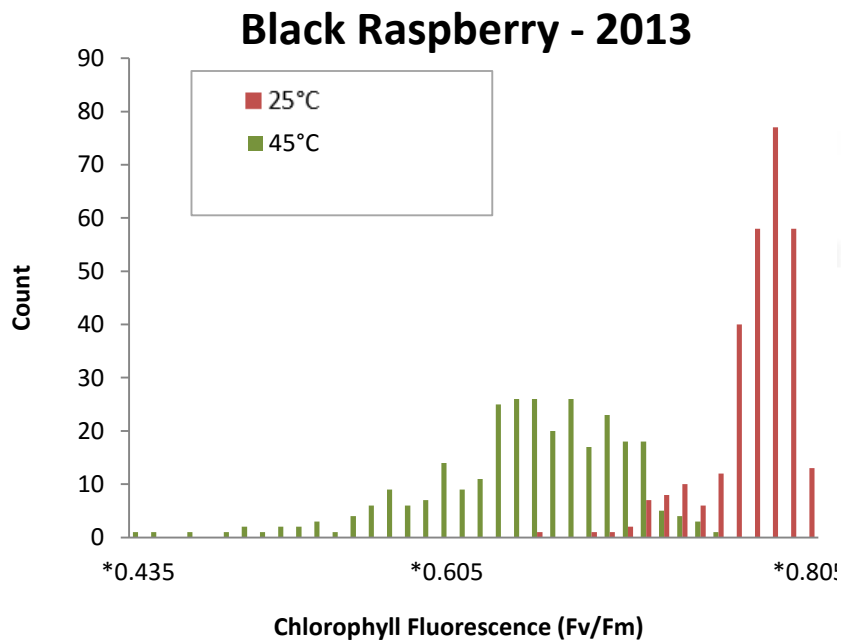
# Results



Averaged over all locations, population ORUS 4304 flowers over a longer interval than ORUS 4305 and has a wider range of ripening dates in 2014.



- Breeding is moving toward more heat tolerance.
- Trait distribution for heat tolerance is similar in red and black raspberry at the same site in NC. (Molina-Bravo 2009)

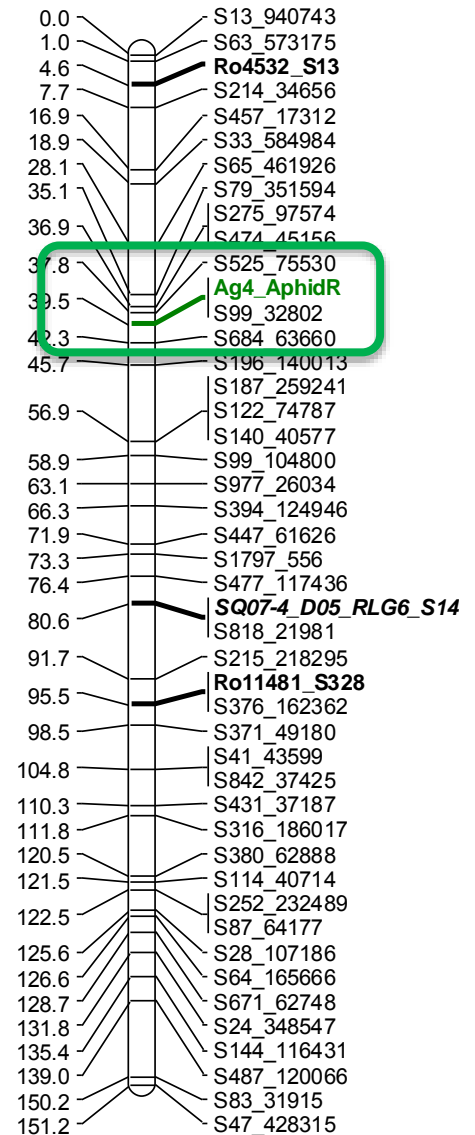






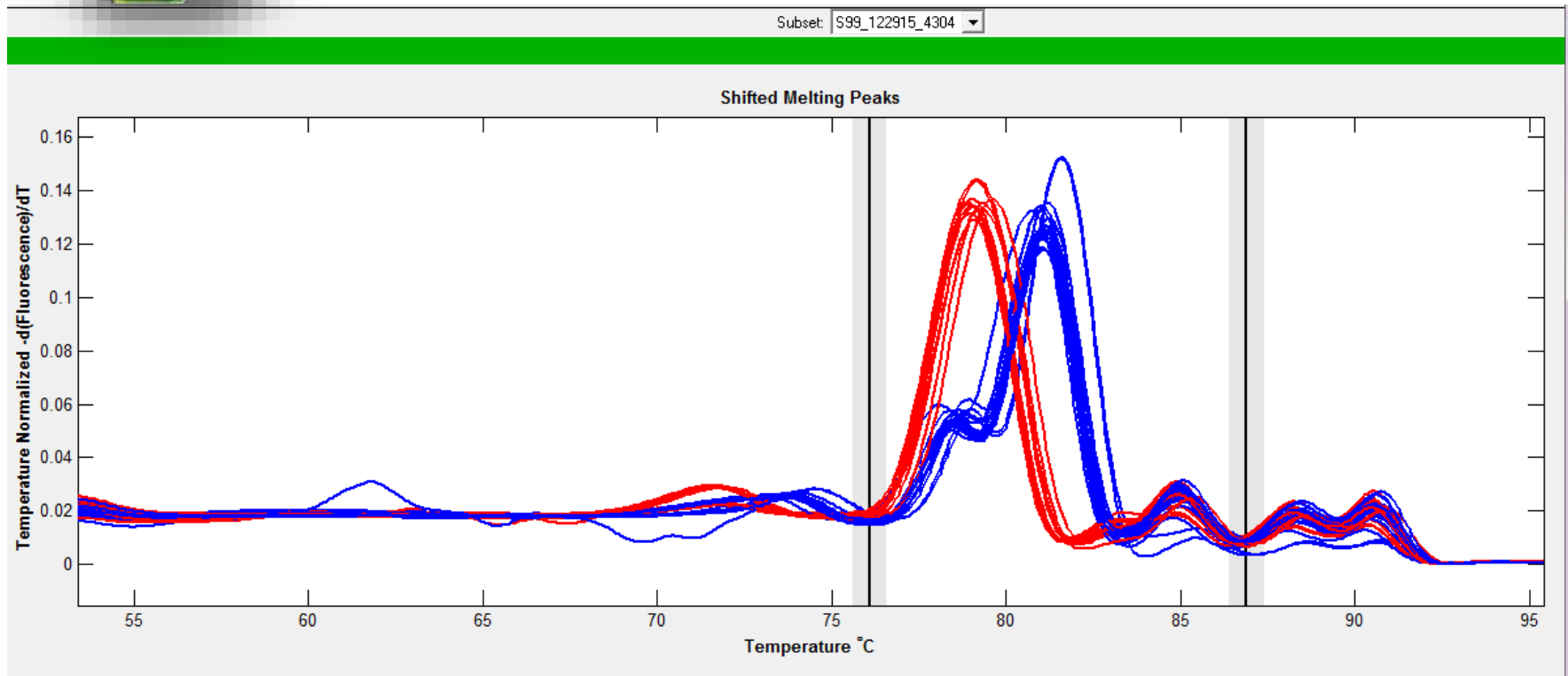
# Molecular Biology/Genomics

- Genome sequence
  - Genetic maps = gene and DNA tests for aphid resistance
- = faster breeding for better fruit





# Molecular Biology/Genomics



BLUE peak = Resistant to aphids  
RED peak = Susceptible to aphids

# Product Evaluation



Genotype	# of responses					Comments
	Poor	Fair	Good	V. Good	Excellent	
4-51			7	1		Not as flavorful, nice
4-82		1	2	4	1	Seedy (2), soapy, nice flavor, small
4-121		1	4	3		Good!
4-138	1	2	4	1		Seedy, bland
4-192		3	3	2		Soapy, not very strong flavor (2)
5-19		1	1	4	2	Sweet (2), good flavor (2), too small, not sweet or sour, not much taste
Mac Black	1	3	2	1	1	Seedy, too tart, tart (2), sour





# Communication and Marketing



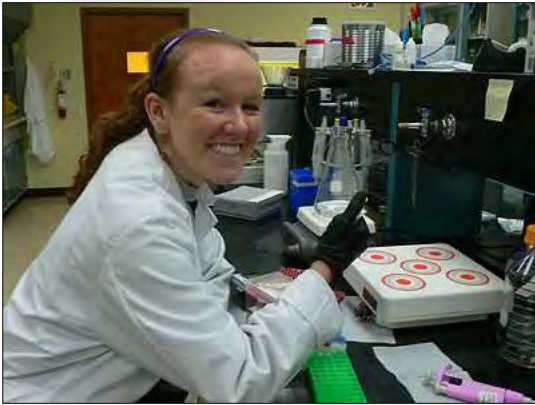
Extension:

- Field Days
- Grower Meetings & Events

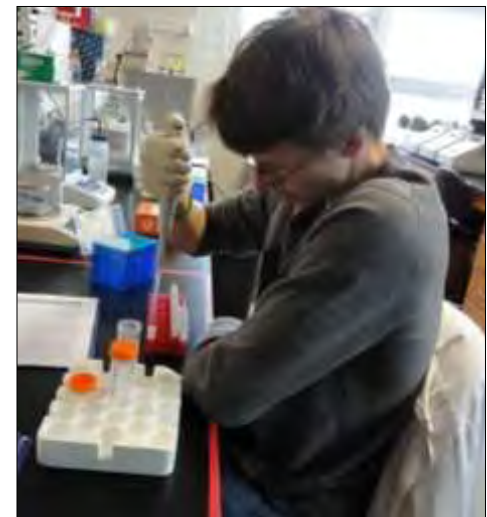




# Communication and Marketing



Student Interns  
and  
Opportunities



# Communication and Marketing



**Growing Produce**    Vegetables ▾    Fruits ▾    Nuts    Citrus ▾    Farm Marketing

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[New Partnership Sends Florida Strawberries To Puerto Rico](#)

[Southern Strawberry, Peach Growers Concerned About Cold Snap](#)

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## Building A Better Black Raspberry

By: Gina Fernandez, Jill M. Bushakra, Christine Bradish, Chad Finn

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*(Photo Credit: Gina Fernandez, NC State)*

**B**lack raspberries are a minor crop, even among the berry crops. The majority of the berry-consuming public only knows of them as a processed product, such as jam and juice, and few people have ever had them fresh. However, it has not always been that way.

In the early 1900s, black raspberry production was centered in and around western New York and exceeded the production of red raspberry.

By the 1940s, disease problems shifted production to Oregon, where the crop is now grown and harvested mechanically for processed products.

In the past decade there has been a growing amount of data extolling the health benefits of dark fruits in general, and black raspberries specifically. These discoveries have led to a demand for fresh product and the potential for increased production range.

Despite the potential, there are many challenges for this crop including low yield, poor regional adaptation, and disease and insect susceptibility. In addition, there have been few new cultivars released due to a lack of breeding effort and a lack of genetic



# What makes the ideal black raspberry?

- End market:
  - Fresh vs. processing
  - Machine vs. hand harvest
- Consistency
- Uniformity
- Pest and disease resistant







## Future Directions

Will there be a new black raspberry from this work?

- **NO**, but...
  - Selected high-performing individual plants to be used in future crosses
  - developed molecular tools that can be used in both black and red raspberry







Thank you!

Want More Info????

[www.black-raspberries.com](http://www.black-raspberries.com)



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WASHINGTON Red Raspberries

USDA-NIFA Specialty Crop Research Initiative

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