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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)

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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)

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Background & Introduction

ars.usda.gov

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

(Halgren et.al 2007)

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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)

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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

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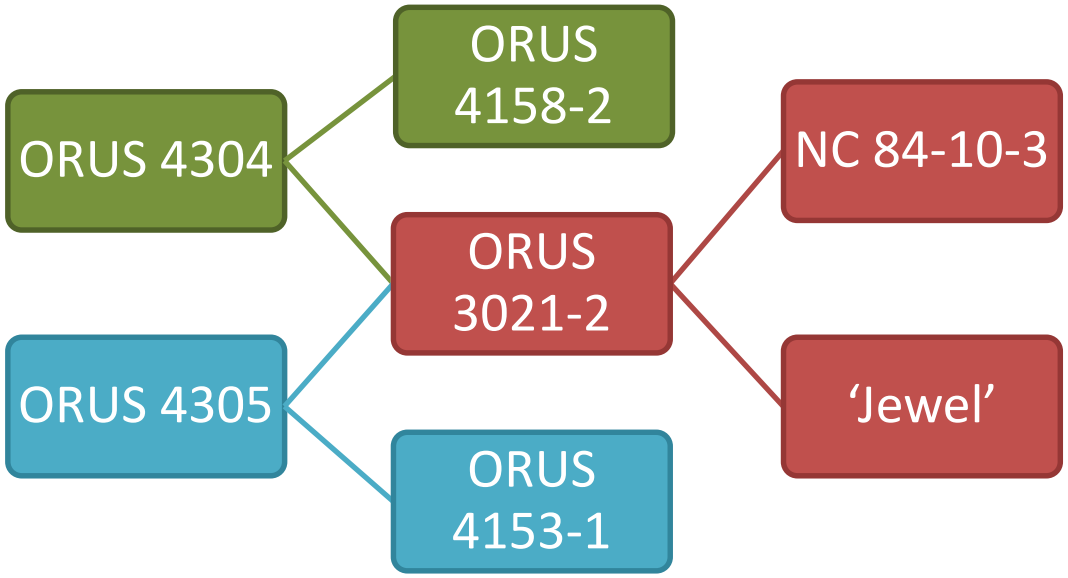
Plant Background

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

Population 2 – 115 Plants



Wild source of aphid resistance from Ontario

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Research Sites

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

Oregon
44.5°, -123.3°;
elevation 72m

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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

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Results

State x	NC	OR	OH	NY	*p*-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

Tables courtesy of J. Bushakra

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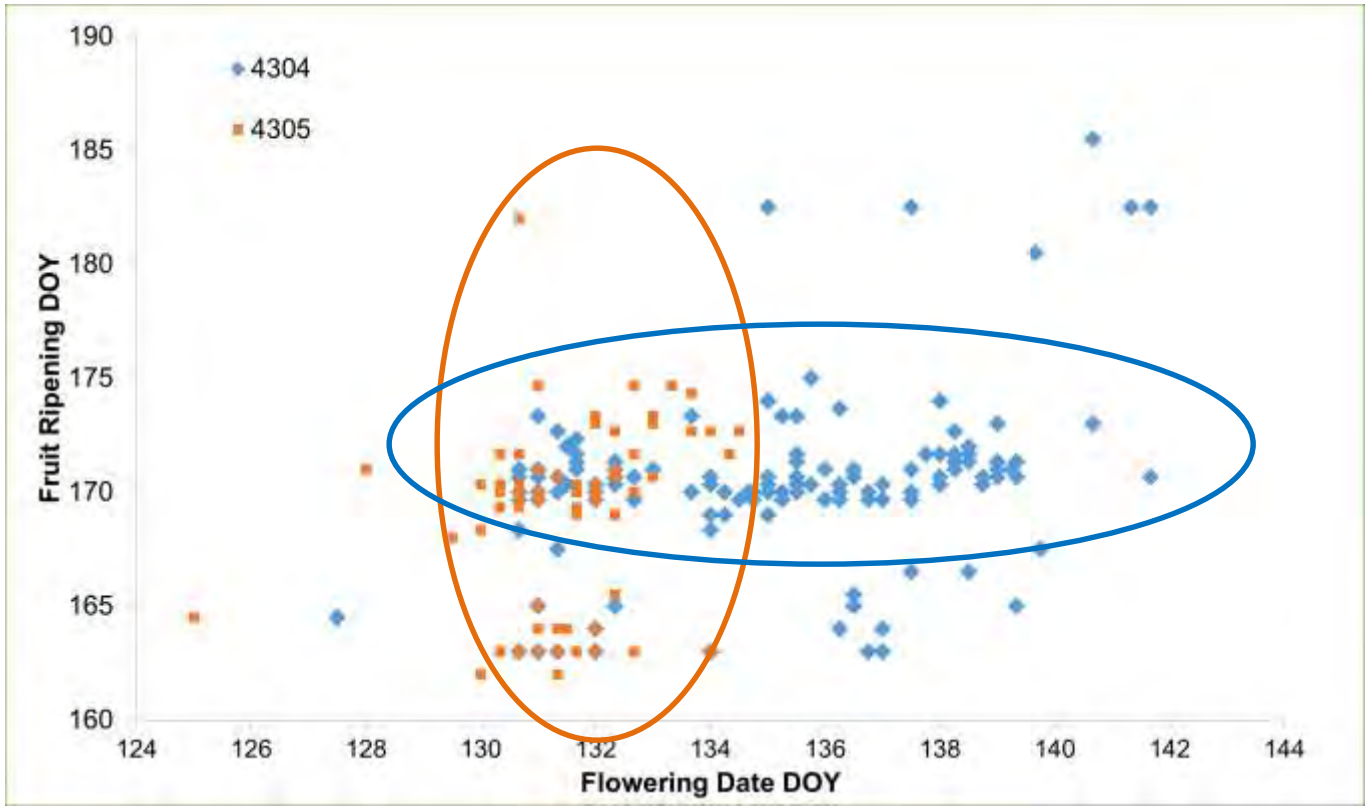
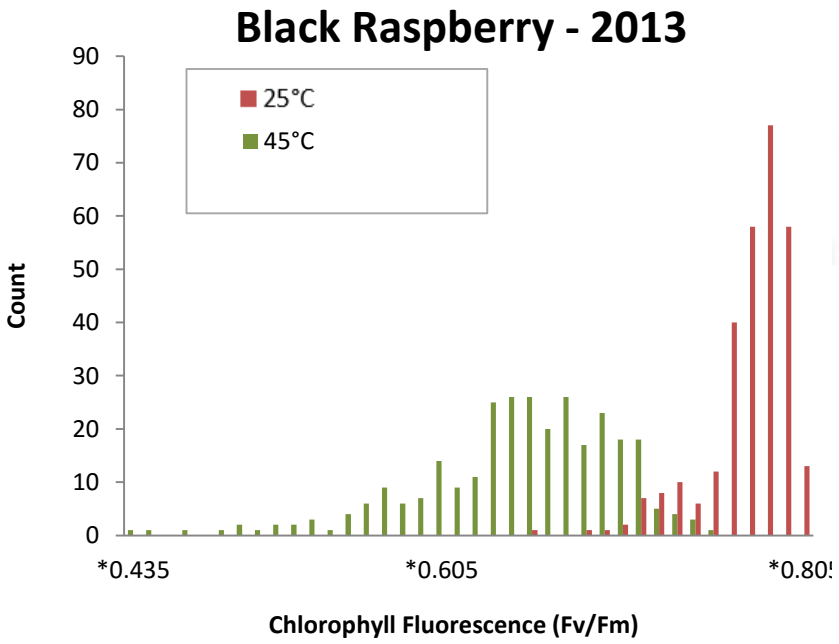
Results

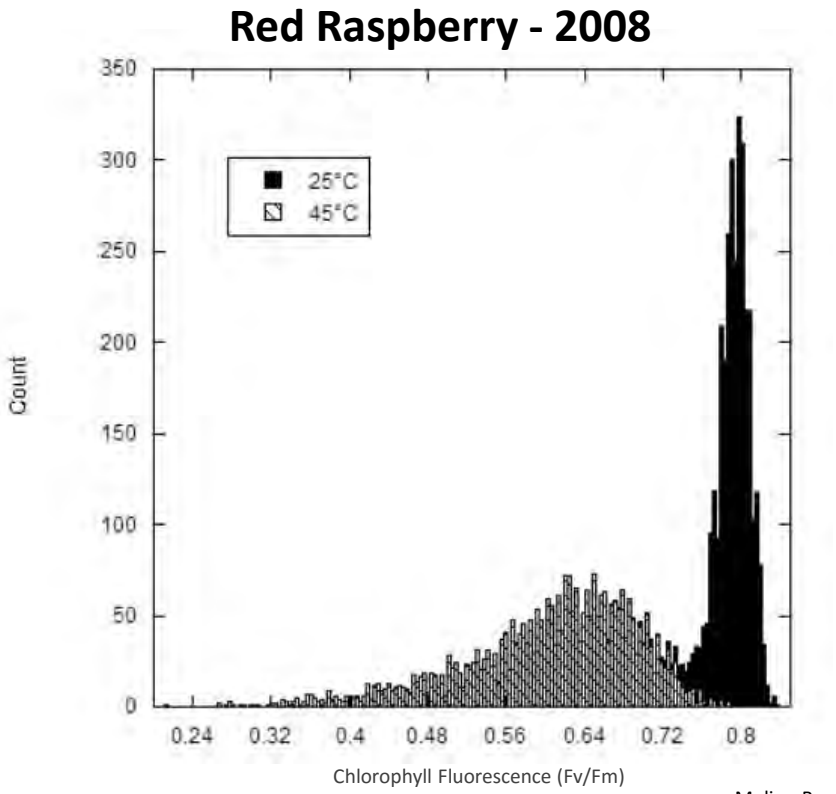


Averaged over all locations, population ORUS 4304 flowers over a longer interval than ORUS 4305 and has a wider range of ripening dates in 2014.

Figure courtesy of J. Bushakra

- 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)





Molina-Bravo 2009

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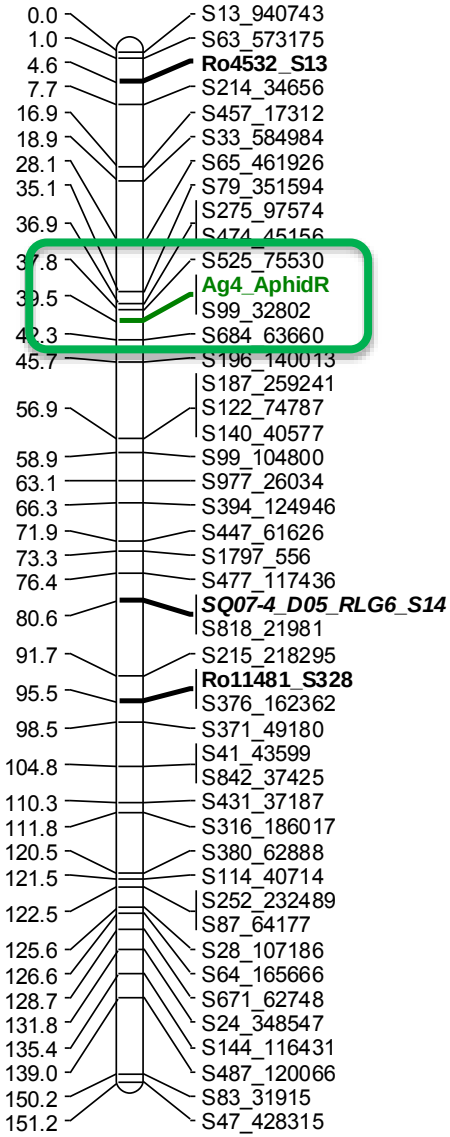
Molecular Biology/Genomics

- Genome sequence
- Genetic maps = gene and DNA tests for aphid resistance

= faster breeding for better fruit



Molecular Biology/Genomics

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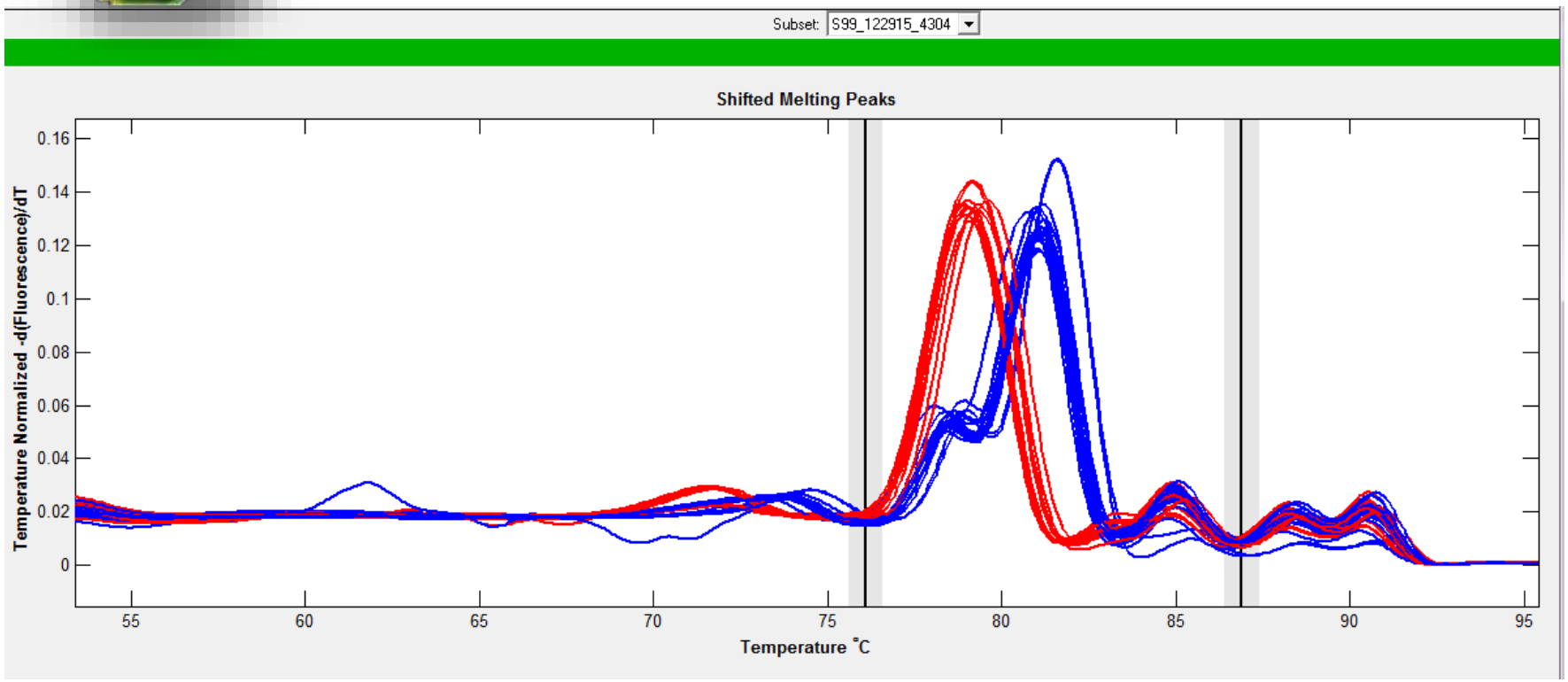

BLUE peak = Resistant to aphids

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

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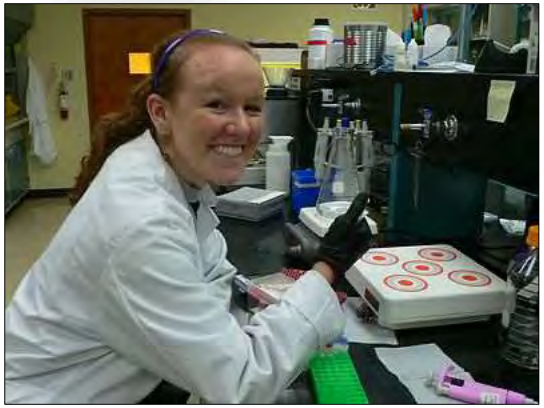
Communication and Marketing

Extension:

- Field Days
- Grower Meetings & Events

Communication and Marketing



Student Interns
and
Opportunities

Communication and Marketing

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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

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Thank you!

Want More Info????

www.black-raspberries.com

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USDA-NIFA Specialty Crop Research Initiative

USDA-ARS CRIS 5358-21000-038-00D, 5358-21000-041-00D, 5358-21000-037-00D