Welcome to the webinar!

- The webinar will start at the top of the hour.
- To type in a question, use the question box on your control panel. We will read the questions aloud after the c. 45 minute presentation.
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Patrick Moore
WSU Puyallup

Raspberry Breeding for the Pacific Northwest

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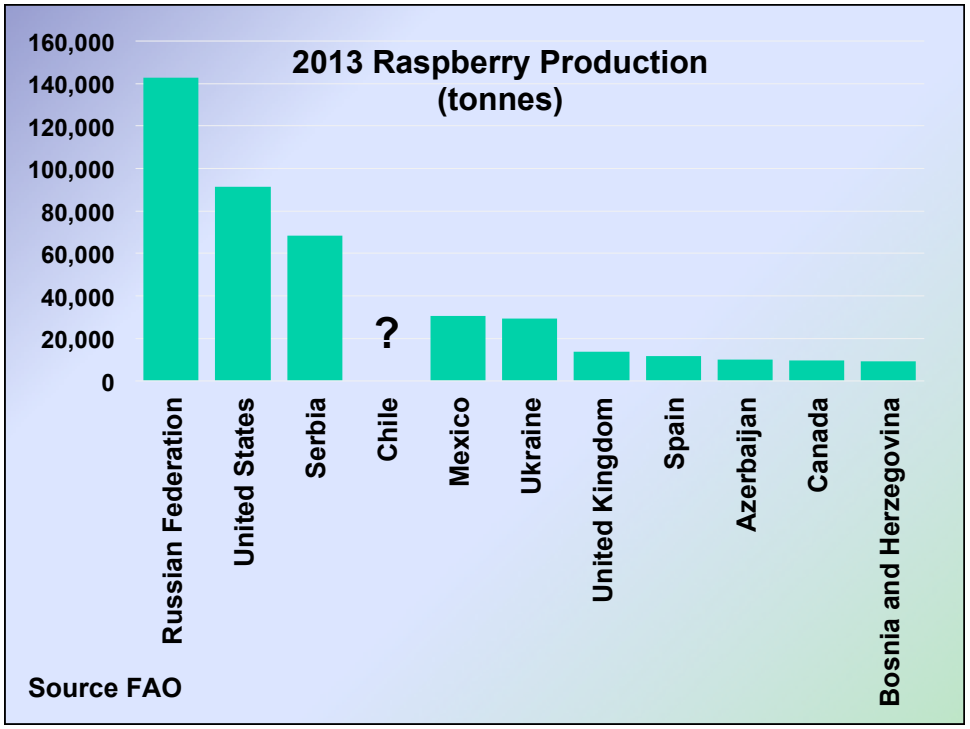
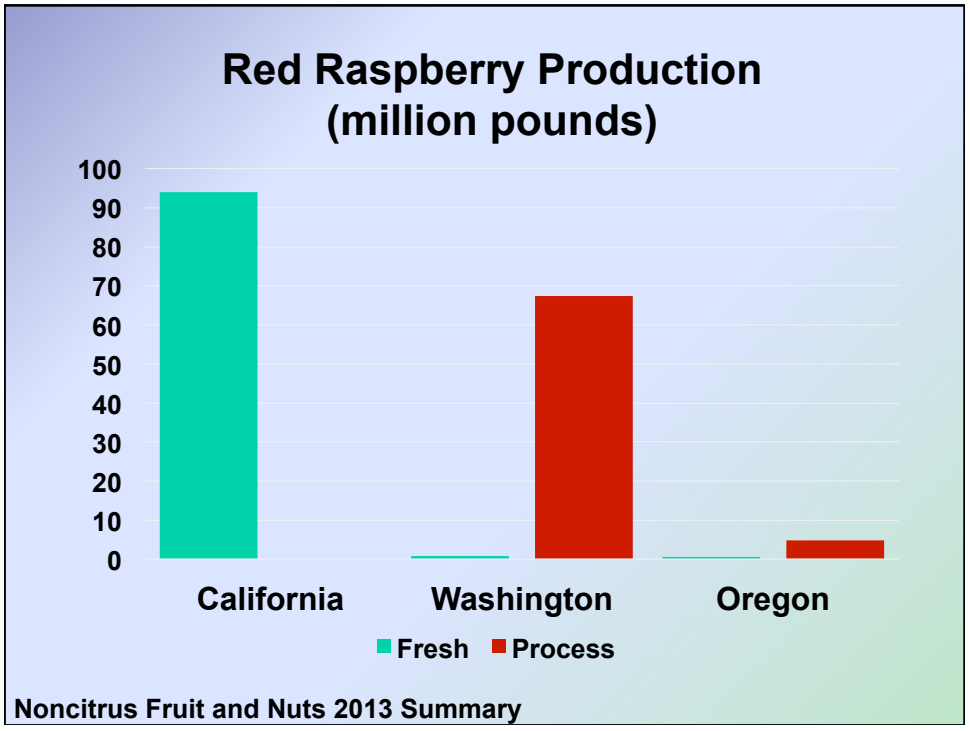
Cooperators
Chad Finn, USDA/ARS, Corvallis, OR
Michael Dossett, BC Blueberry Council
In partnership with: AAFC

Program support
- **Washington State University**
- **USDA-ARS NW Center Small Fruits Research**
- **Washington Red Raspberry Commission**
- **Washington Strawberry Commission**
- **Oregon Strawberry Commission**
- **Oregon Raspberry and Blackberry Commission**
- **Plant Royalties**
- **This work was partially funded by USDA/NIFA through Hatch Projects #WNP0038 and 0640**


2013 Raspberry Production
(tonnes)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
?
Russian Federation
United States
Serbia
Chile
Mexico
Ukraine
United Kingdom
Spain
Azerbaijan
Canada
Bosnia and Herzegovina
Source FAO


Red Raspberry Production
(million pounds)
100
90
80
70
60
50
40
30
20
10
0
California
Washington
Oregon
Fresh
Process
Noncitrus Fruit and Nuts 2013 Summary

Red Raspberry

Rosaceae - family

***Rubus* - genus**

***Ideaobatus* – subgenus**

***R. idaeus* L. - species**

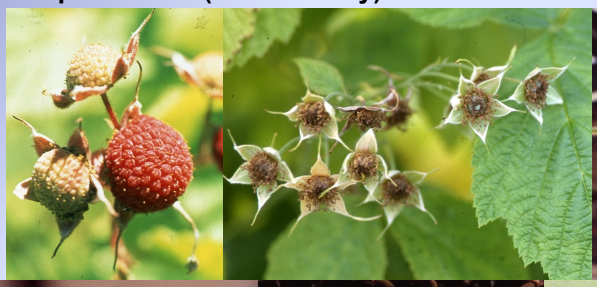
***R. idaeus* L. subsp. *vulgatus* Arrh.**	**European red raspberry (*R. idaeus*)**
***R. idaeus* L. subsp. *strigosus* Michx.**	**North American red raspberry (*R. strigosus*)**

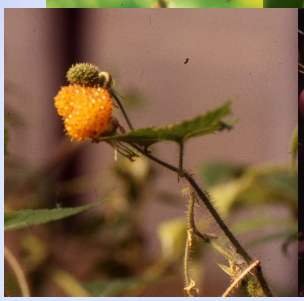
R. idaeus – diploid 2n=14

R. cockburnianus*
R. coreanus*
R. crataegifolius*
R. flosculosus
R. innominatus*
R. lasiostylus*
R. niveus
R. occidentalis* – black raspberry
***R. odoratus* – flowering raspberry**
***R. parviflorus* – thimbleberry**
R. phoenicolasis*
R. pungens*
***R. spectabilis* - salmonberry**
R. sumatranus
PI 305308*

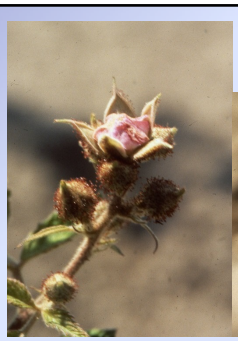
Rubus parviflorus (thimbleberry) 3 selections

Rubus innominatus
6 selections



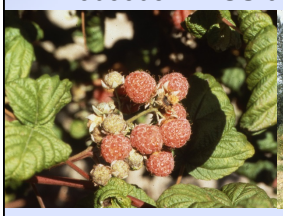


Rubus sumatranus 3 selections

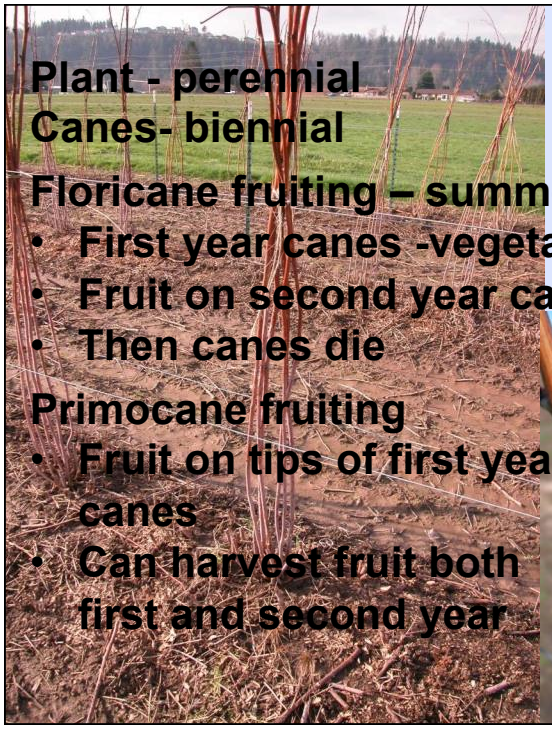


PI 305308

PI 305308 x WSU 930 6 selections



Have 4 selections of BC_6



Plant - perennial
Canes- biennial

Floricane fruiting – summer fruiting
- First year canes -vegetative only
- Fruit on second year canes
- Then canes die

Primocane fruiting
- Fruit on tips of first year canes
- Can harvest fruit both first and second year

Clonally propagated – genetically identical from root cuttings or tissue culture

Need to be self fertile


Raspberry Breeding Goals
Flavor, Firmness, Color for processing
Machine harvestable
High yield
Virus resistant
Root Rot tolerant
IQF quality (Individual Quick Frozen)

Select parents
Make crosses
Grow seedlings
Make selections
Evaluate for traits of interest
If still promising
    Grower Trials
Possible release

	Cross	Release	Years
Tahoma	1931	1938	7
Washington	1931	1938	7
Goldenwest	1931	1953	22
Sumner	1935	1956	21
Puyallup	1940	1953	13
Meeker	1950	1967	17
Centennial	1974	1989	15
Cascade Gold	1979	2010	31
Cascade Dawn	1988	2005	17
Cascade Delight	1989	2003	14
Cascade Nectar	1990	2003	13
Cascade Bounty	1992	2005	13
Cascade Harvest	1998	2013	15
			15.8

Pollinations

Average 74 crosses/year in past 5 years
Generally emasculate 3-5 flowers/bag, 2-3 bags/cross
Goal 200 seeds/cross

Seed Treatment

Scarify seed - sulfuric acid
Stratify – cold, moist 6 weeks
Sow seed in greenhouse
Goal 100 seedlings/cross

Plant seedlings

Average 5,500 seedlings
5,500 = 3.0 A, 3.125 miles of row

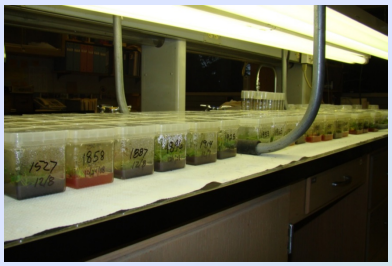
Make selections

Evaluate two years after planting
Evaluate all fruiting seedlings at least once a week
Select ≈ 1% of seedlings

Subjectively evaluate for

- Vigor – health
  - Root rot tolerance
- Yield
- Growth habit
- Color, size, appearance
- Firmness, ease of fruit release
- Flavor
- Flag desirable seedlings (selections)
- Propagate Selections

Propagate via tissue culture



Evaluation of selections

Root tc plants in greenhouse

Plant with cooperating growers

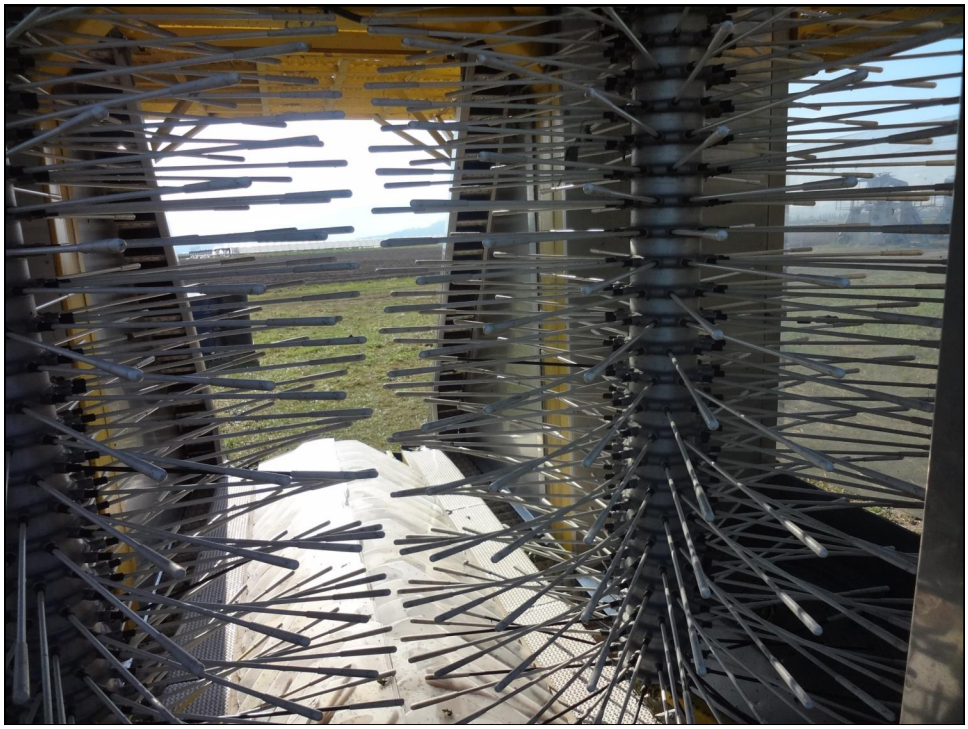
Grown under (mostly) commercial practices by cooperating grower
Harvested commercial schedule

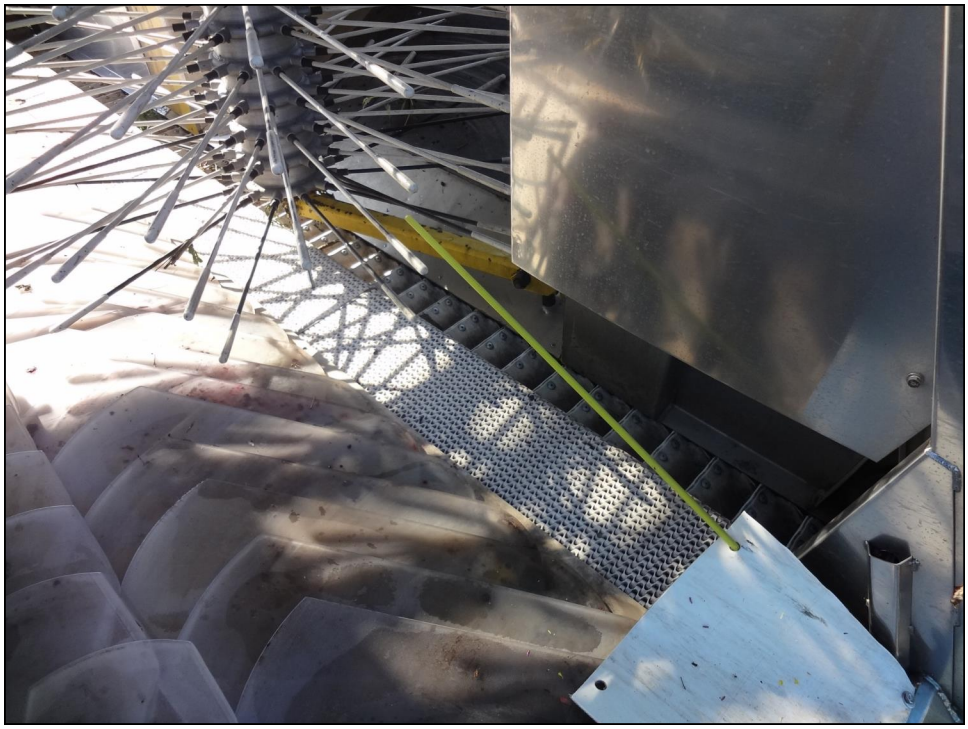
Breeding for machine harvestability

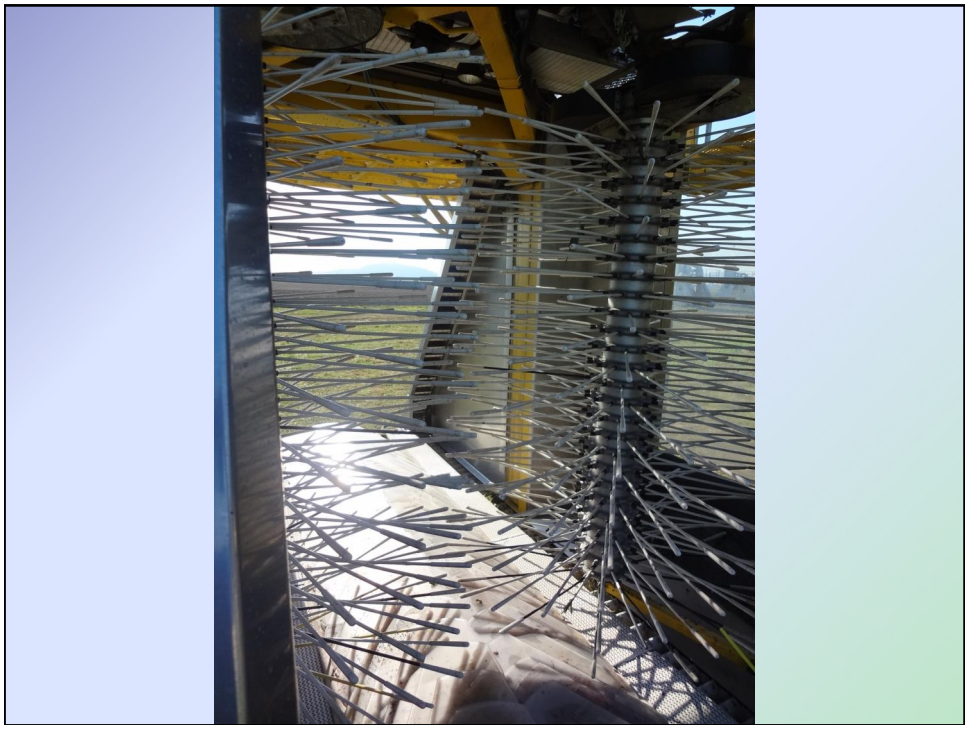
Harvest every 1 ½ - 3 days (15-20/season)

Processing
Fruit quality

Littau
Oxbo







Evaluate subjectively for
Green
Overripe
Collapsed
Crumbly fruit
Yield
Color, Size, Firmness, Flavor
Fruit sample for analysis for most promising selections

Need

- **Easy fruit release**
- **Firm, durable fruit**
- **Good lateral length**
- **Good lateral attachment**

Traits affecting machine harvestability

Abscission of pedicel
Abscission from receptacle
Fruit cohesion
Receptacle shape
Drupelet position
Receptacle length
Fruit firmness
Size of drupelets
Break at fruit opening
Long, weak laterals

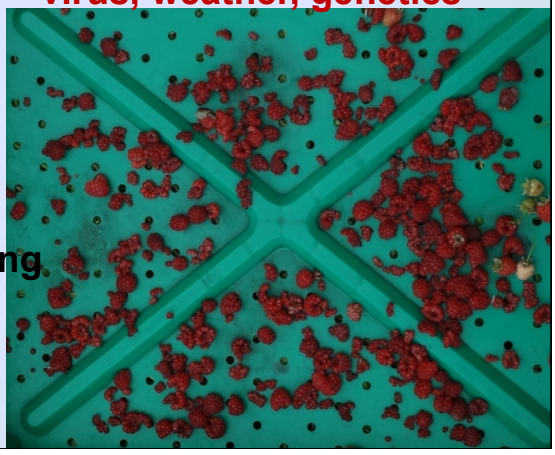
Traits affecting machine harvestability

Abscission of pedicel
Abscission from receptacle
Fruit cohesion
Receptacle shape
Drupelet position
Receptacle length
Fruit firmness
Size of drupelets
Break at fruit opening
Long, weak laterals

Cascade Dawn

Traits affecting machine harvestability

Abscission of pedicel
Abscission from receptacle
Fruit cohesion — virus, weather, genetics
Receptacle shape
Drupelet position
Receptacle length
Fruit firmness
Size of drupelets
Break at fruit opening
Long, weak laterals



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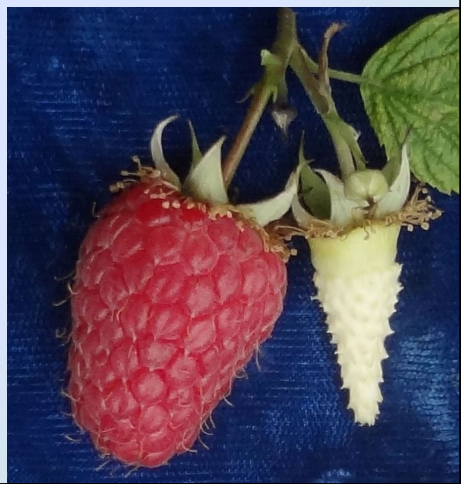

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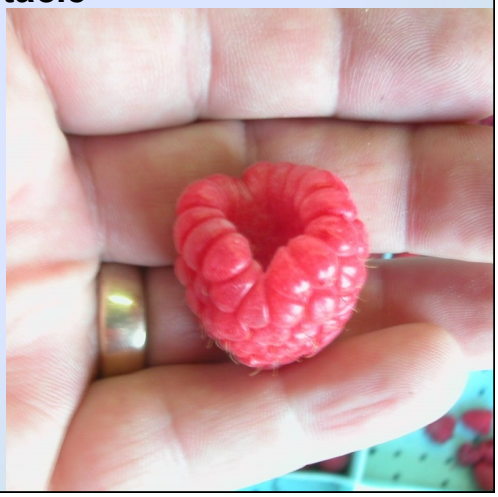

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Seedling evaluation

In grower field
Fruit distribution – broad, bimodal
Decision making time
Concentration
Finding correct plant – repeated selection

Two of the selections made while on the harvester are currently in grower trials. Would they have been selected w/o machine?

After MH evaluation – replant best in new MH trial and replicated plots at WSU Puyallup.

Hand harvest twice each week at WSU Puyallup

Measure good/rot fruit, fruit weight, fruit firmness

Raspberry Root Rot

Phytophthora rubi
More severe on wet, poorly drained sites
Cannot eliminate from soil
Recommended course of action
- Raised beds
- Gypsum
- Fungicides
- Plant tolerant cultivars

Goss Farm naturally infested with "good" levels of root rot.
Provides a natural screen for the seedlings, but some escapes.

Evaluate advanced selections after MH evaluations in a field, known to have root rot

Raspberry Bushy Dwarf Virus (RBDV)

RBDV Negative

RBDV Positive

RBDV Negative

RBDV Positive

Raspberry Bushy Dwarf Virus

Pollen borne, systemically infects plant, including seeds

Causes partial sterility of fruit
- fruit crumbles

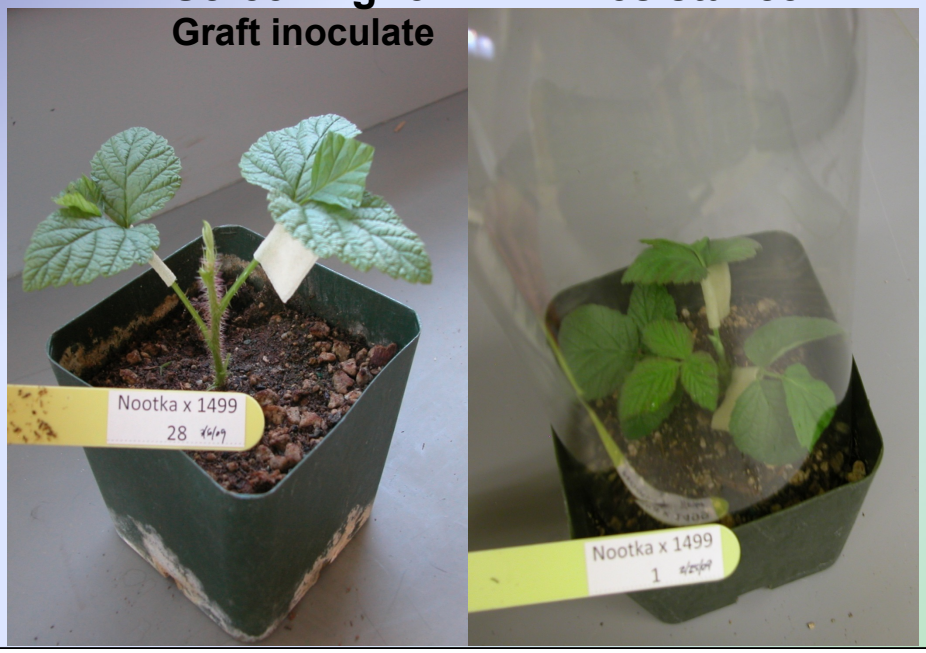
Estimated impact of RBDV
- Growing a susceptible cultivar
- IQF quality
- >$1,500/A/year
- Losses in yield, fruit quality, replant

No cultural management options, other than replant with clean plants.

Currently no significant plantings of RBDV resistant cultivars

Screening for RBDV resistance

Graft inoculate



Resistance to RBDV conferred by a single dominant allele (Bu)

- Bu/Bu resistant
- Bu/bu resistant
- bu/bu susceptible

Should be simple to breed for RBDV resistance

Has been very difficult to breed for resistance

- Only symptom in fruit
- Uneven distribution of disease pressure
  - Seedlings fruit for first time two years after planting, when evaluated first time
- Don't screen seedlings or new selections
- Grafting slow, only on elite selections

Use of markers in raspberry breeding

Would be valuable for	Work at Cornell
RBDV resistance	2 markers correct
Root rot tolerance	58/60, but …
Aphid resistance	2 QTL account for
Machine harvestability	25-60%

Have segregating populations in field that might generate some useful markers

Further Resources

Hall, HK, KE Hummer, AR Jamieson, SN Jennings and CA Weber. 2009. Raspberry Breeding and Genetics. In Jules Janick (Ed.) Plant Breeding Reviews Vol 32: 39-353.

"We have all drunk from wells we did not dig and have been warmed by fires we did not build."

- Find all upcoming and archived webinars at http://www.extension.org/pages/60426
- Find the recording for this webinar at http://www.extension.org/pages/72708
- Have a question about plant breeding? Use the eXtension Ask an Expert service at https://ask.extension.org/groups/1714/ask
- Thank you for coming!

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