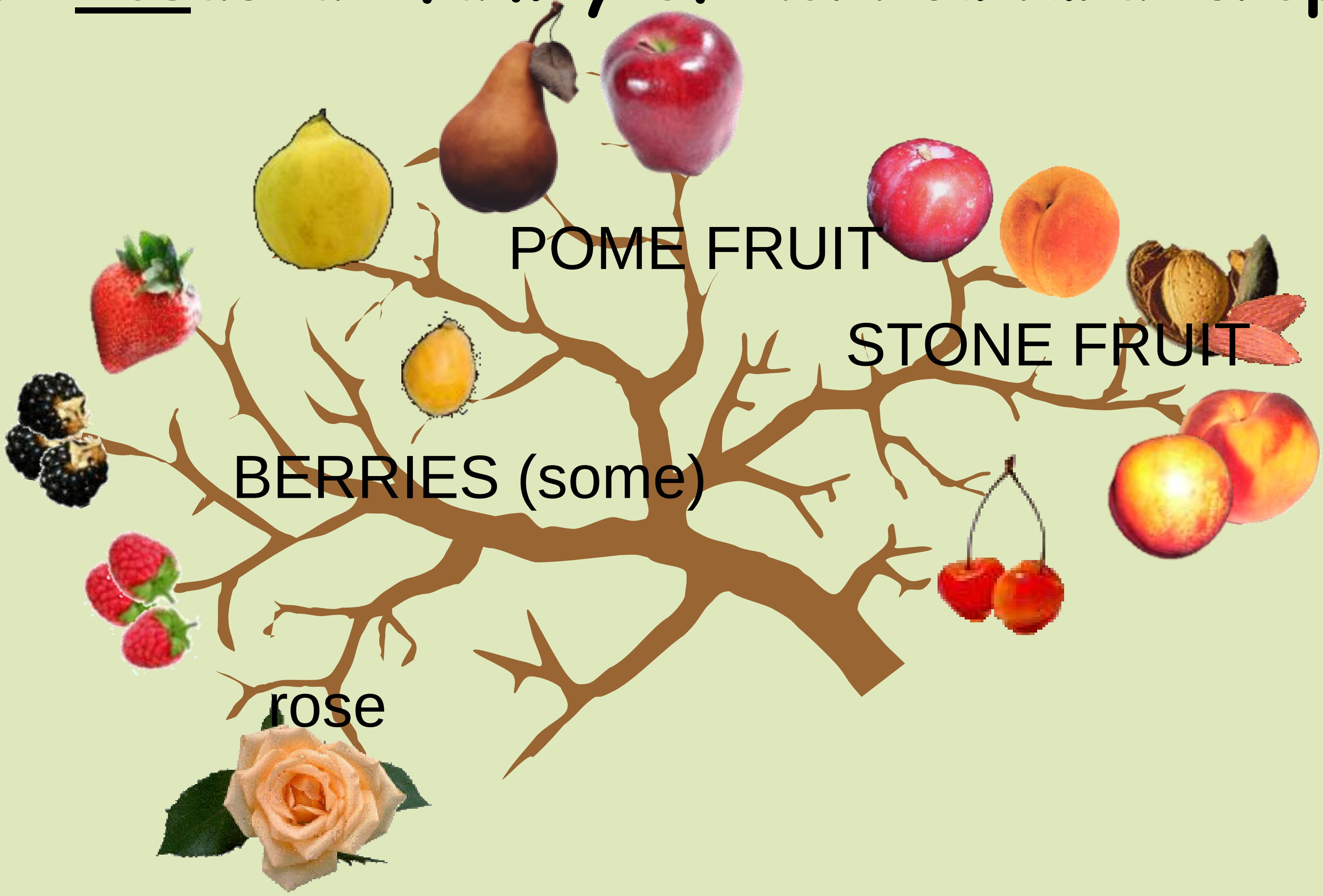
The Rosaceae family of horticultural crops.



RosBREED

Enabling marker-assisted breeding in Rosaceae

Project Overview

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Project Director & Tart Cherry Breeder
www.rosbreed.org

NIFA

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

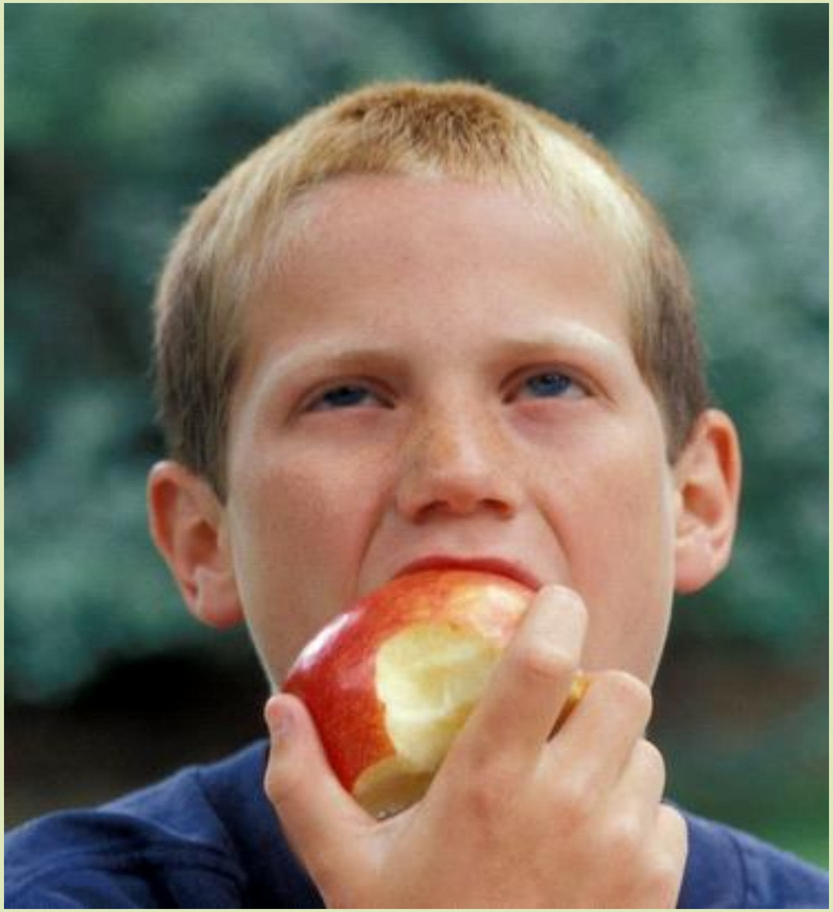
Imagine……

ultra-crisp tasty apples, sweet peaches that do not get mealy, flavorful cherries and strawberries, consistently available from your local grocery store.

These are the kinds of fruits that our RosBREED project can help develop using new genetics and genomics technologies.

Honeycrisp: a breakthrough cultivar

- Honeycrisp apple - introduced 1991 by the Univ of Minn.
- Dramatic attention and U.S. market share this decade.
- An ultra-crisp juicy texture and pleasing flavor
- Required 30 years from crossing to commercialization.



Tree Fruit Breeding

Disadvantages:

- Time consuming (3-20 yrs/generation)
- Large land areas needed for testing
- Field maintenance is expensive (equipment, labor, chemicals)



The power of marker-assisted breeding is to move selection from the field……….to the greenhouse.

- Only elite individuals are planted in the field for further evaluation.
- Plus, with genetic information, parents can be chosen based on robust knowledge of what traits they will transmit to their offspring.

RosBREED Mission Statement

We will develop and apply marker-assisted breeding, based on improved knowledge of industry values and consumer preferences, to accelerate and increase the efficiency of rosaceous cultivar release and successful cultivar adoption.

Why now?

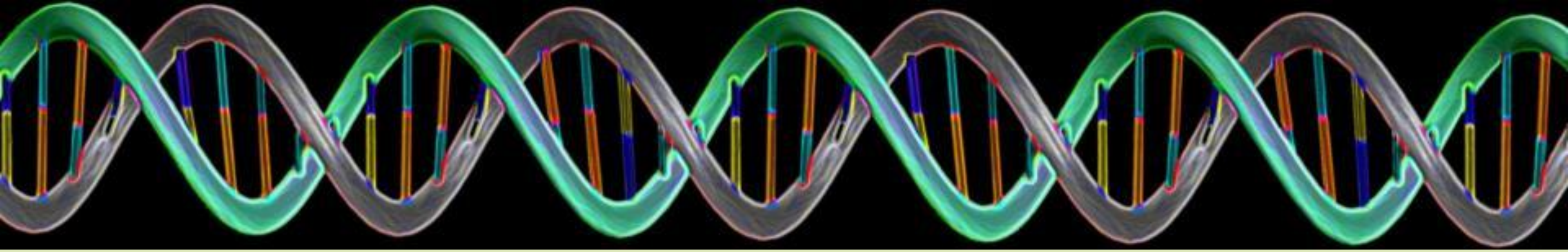


Image courtesy of NSF

Apple, peach & diploid strawberry genome sequences will be available in 2010

Images courtesy of www.beakandskiff.com, www.ehow.com, Jim Hancock

There are over 250 marker-trait associations known in rosaceous crops and just a handful are being used to inform breeding.

<u>Examples of known marker-trait associations.</u>

- DNA markers for the self-fertility alleles in cherry and almond
- DNA marker for the major ethylene gene influencing apple texture

THE CHASM

Marker-trait associations

MAB routine use

Genomics Research

Trait low priority

Different germplasm

Unknown functional alleles

Weak linkage

Unknown genetic action

Unknown environ. effects

Unknown linkage drag

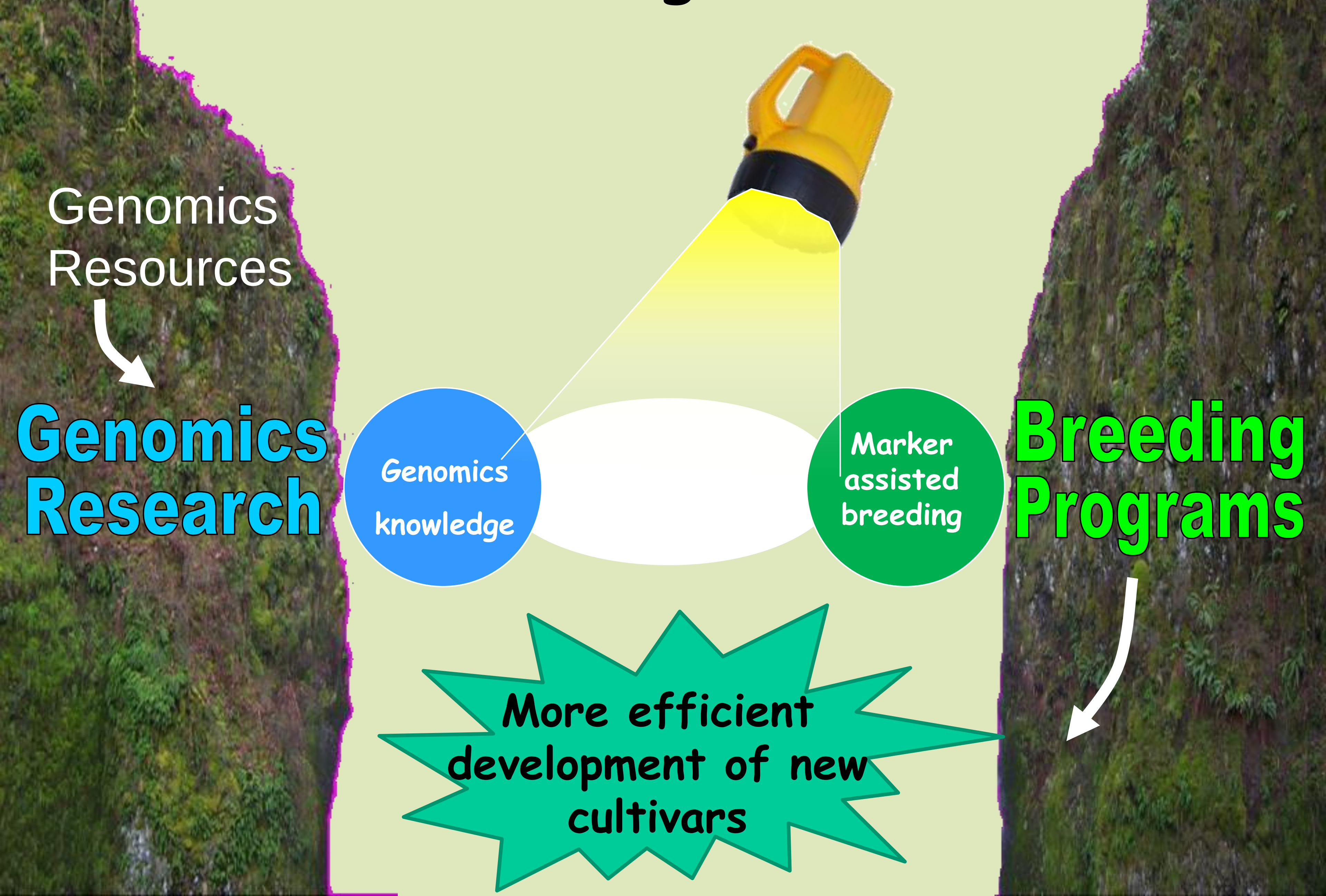
No local genotyping

Not cost efficient

No training in MAB

Breeding Programs

RosBREED bridges this chasm



BRIDGING THE CHASM

RosEXEC: U.S. Rosaceae Genomics, Genetics, & Breeding Executive Committee

Required <u>lots</u> of:

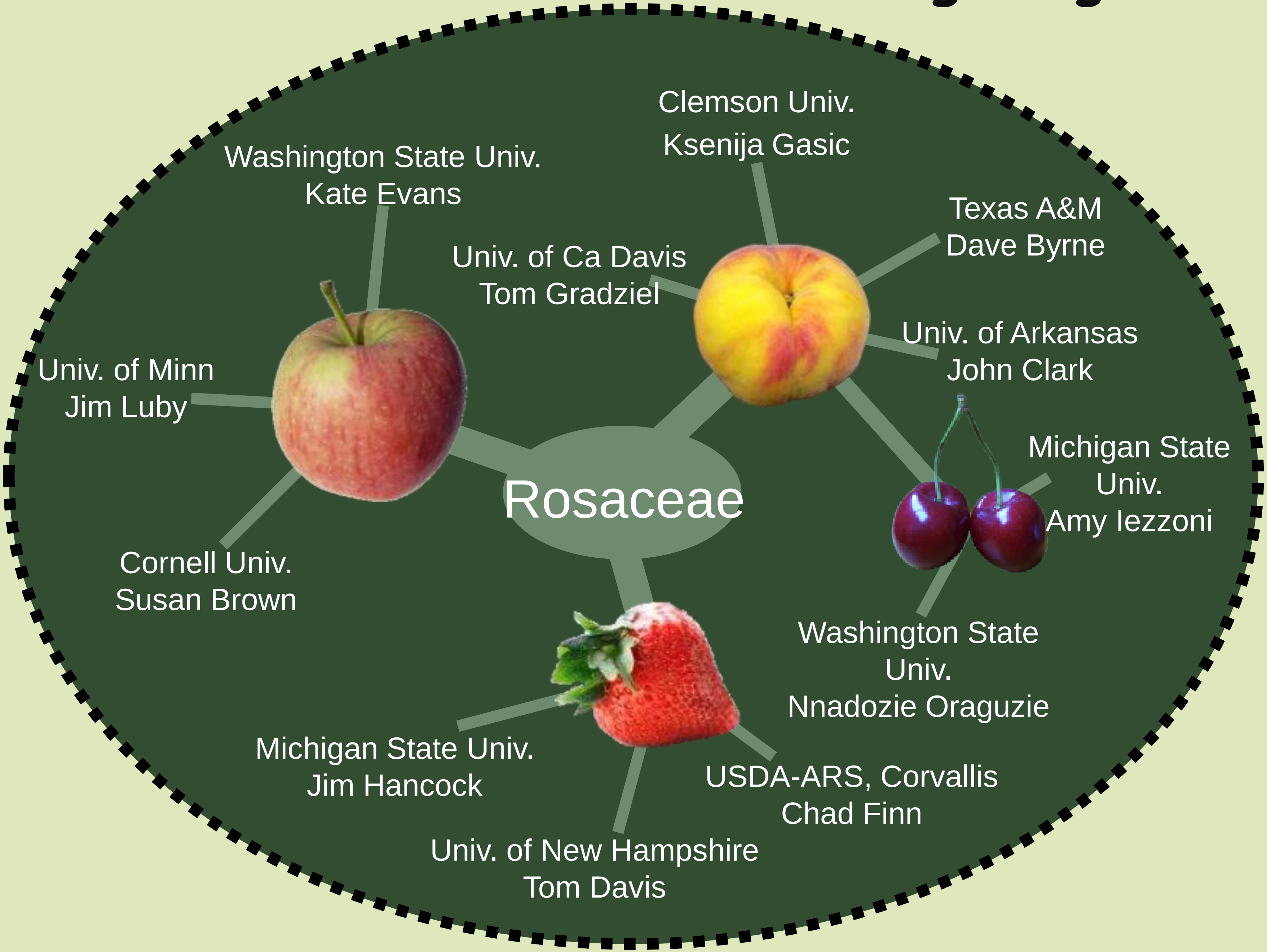
STAKEHOLDER INVOLVEMENT

IDEAS

PLANNING

The Rosaceae Specialty Crops Planning Workshop (22-23 June 2007)

RosBREED Demonstration Breeding Programs

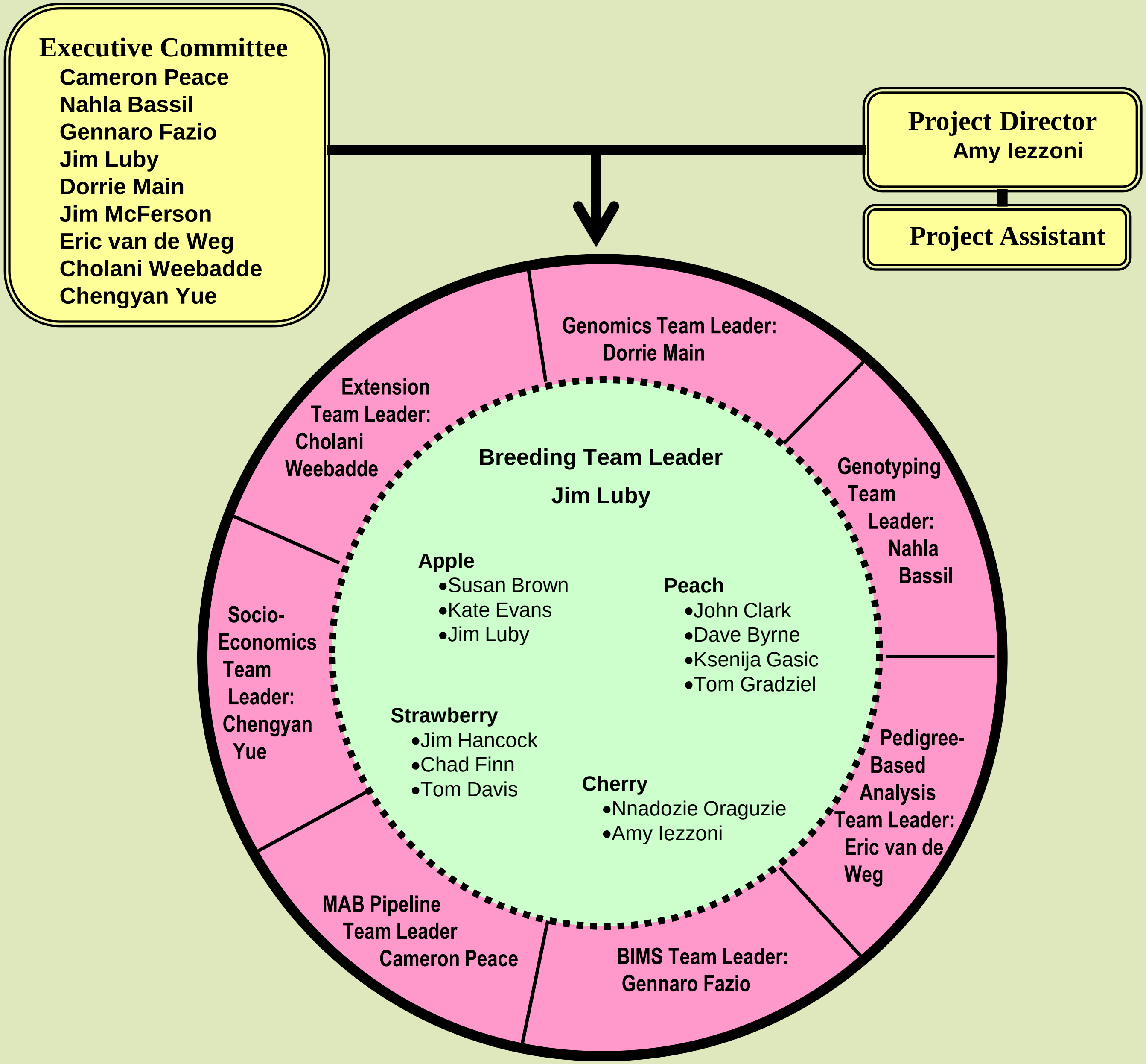


<u>IMPACT</u>: Focus on fruit quality: Demand from consumers and processors for premium cultivars.

<u>NATIONAL IMPACT</u>: Breeders working in all major U.S. production areas for apples, peaches, and cherries are RosBREED Co-PDs.

Source: *The Grower*. Sept/Oct 2009. pg 25.

RosBREED Organization

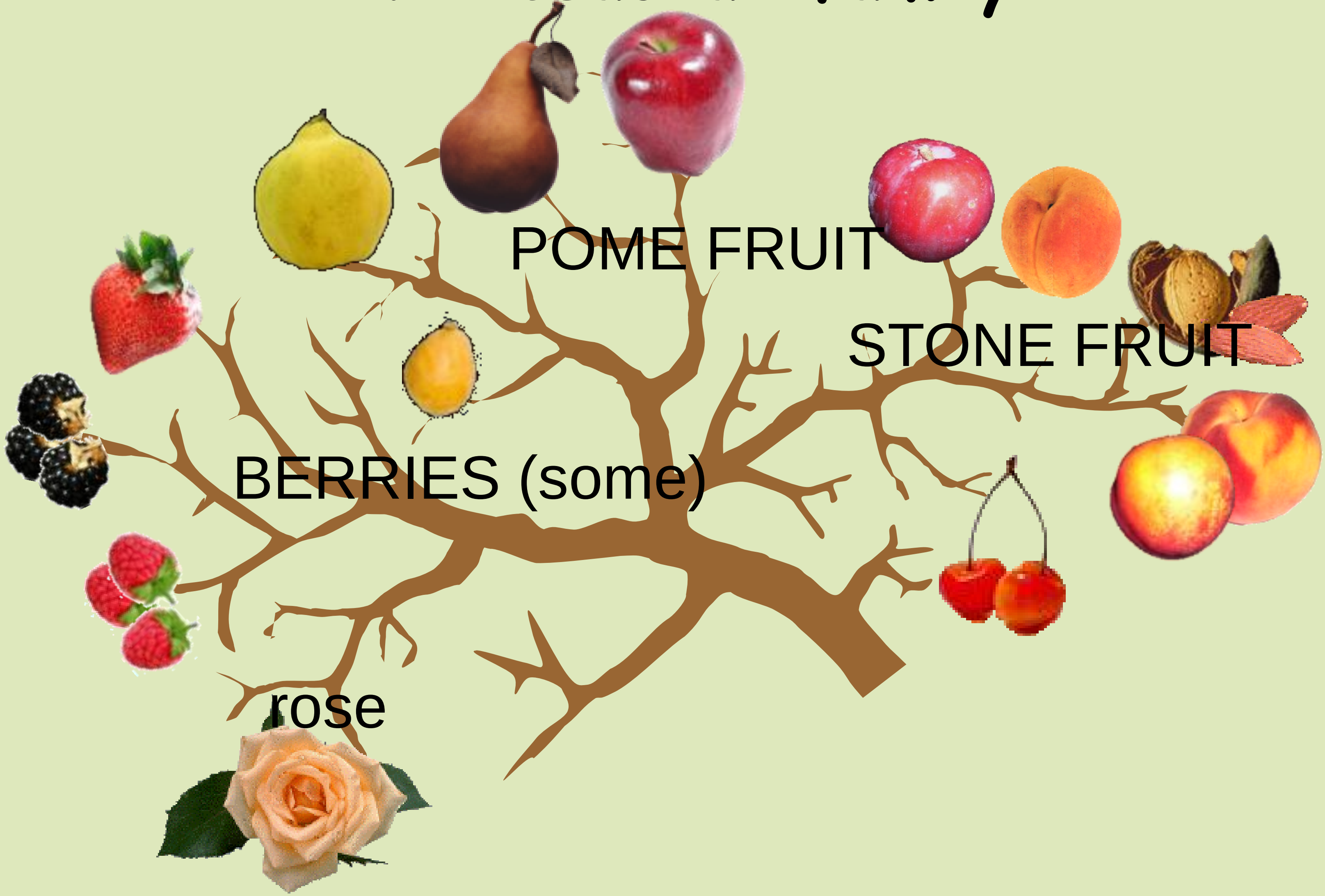


RosBREEDs International Partners.

Plant Research Intl., NL
East Malling Research, UK
INRA – Bordeaux, Avignon & Angers
CRA-FRU Rome

Andres Bello University, Chile
University of the Western Cape, SA
Plant & Food Research, NZ

The Rosaceae family

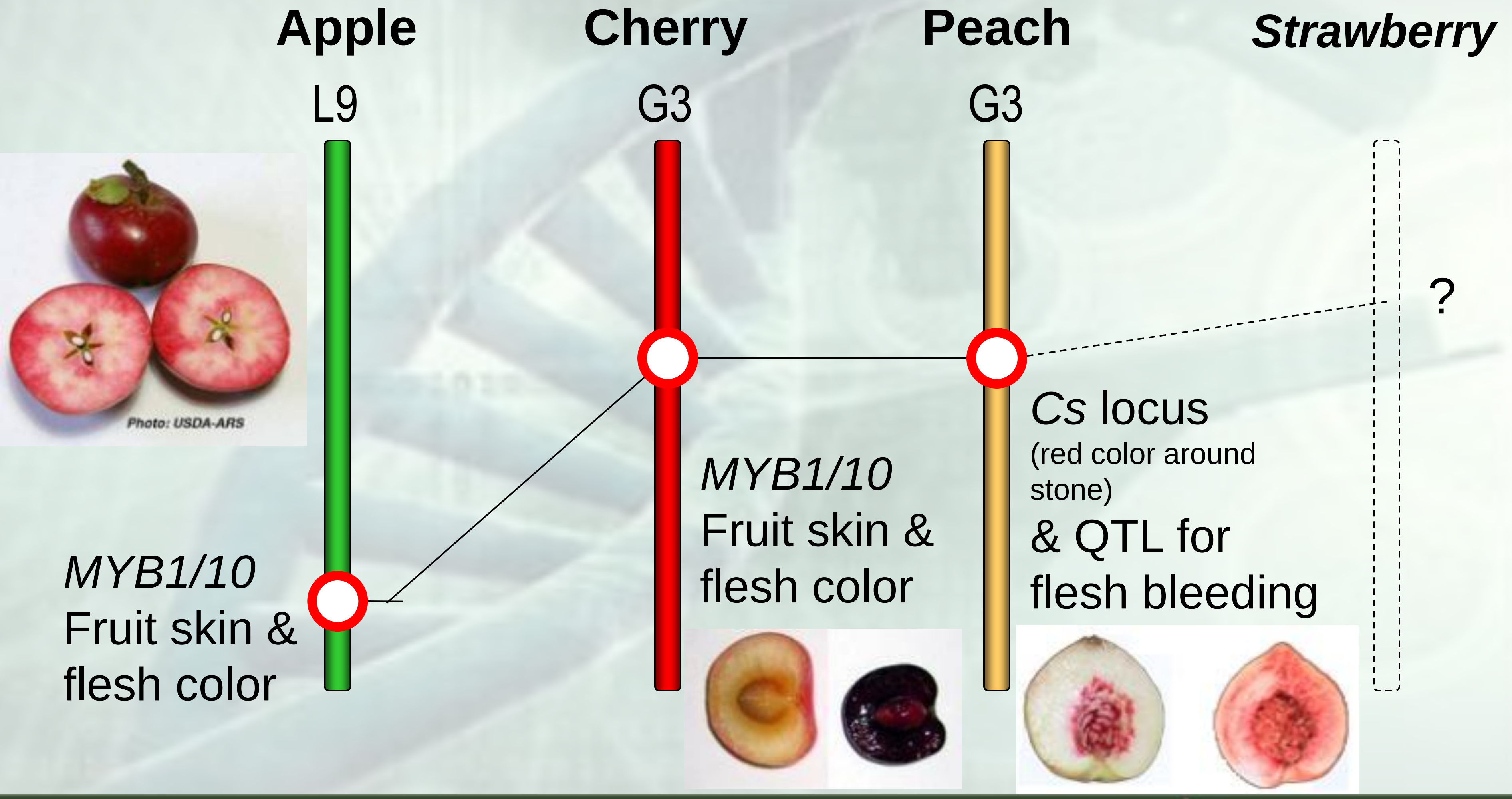


Why should we all work together?

RosBREED is rooted in our vision that the common ancestry of the diverse rosaceaous genera can be harnessed to leverage knowledge and resources across commodity boundaries.

Proof of concept:
Red pigmentation in apple and cherry fruit.

The same gene responsible for red color in apple is thought to be responsible for red color in cherry.



Why should we all work together?

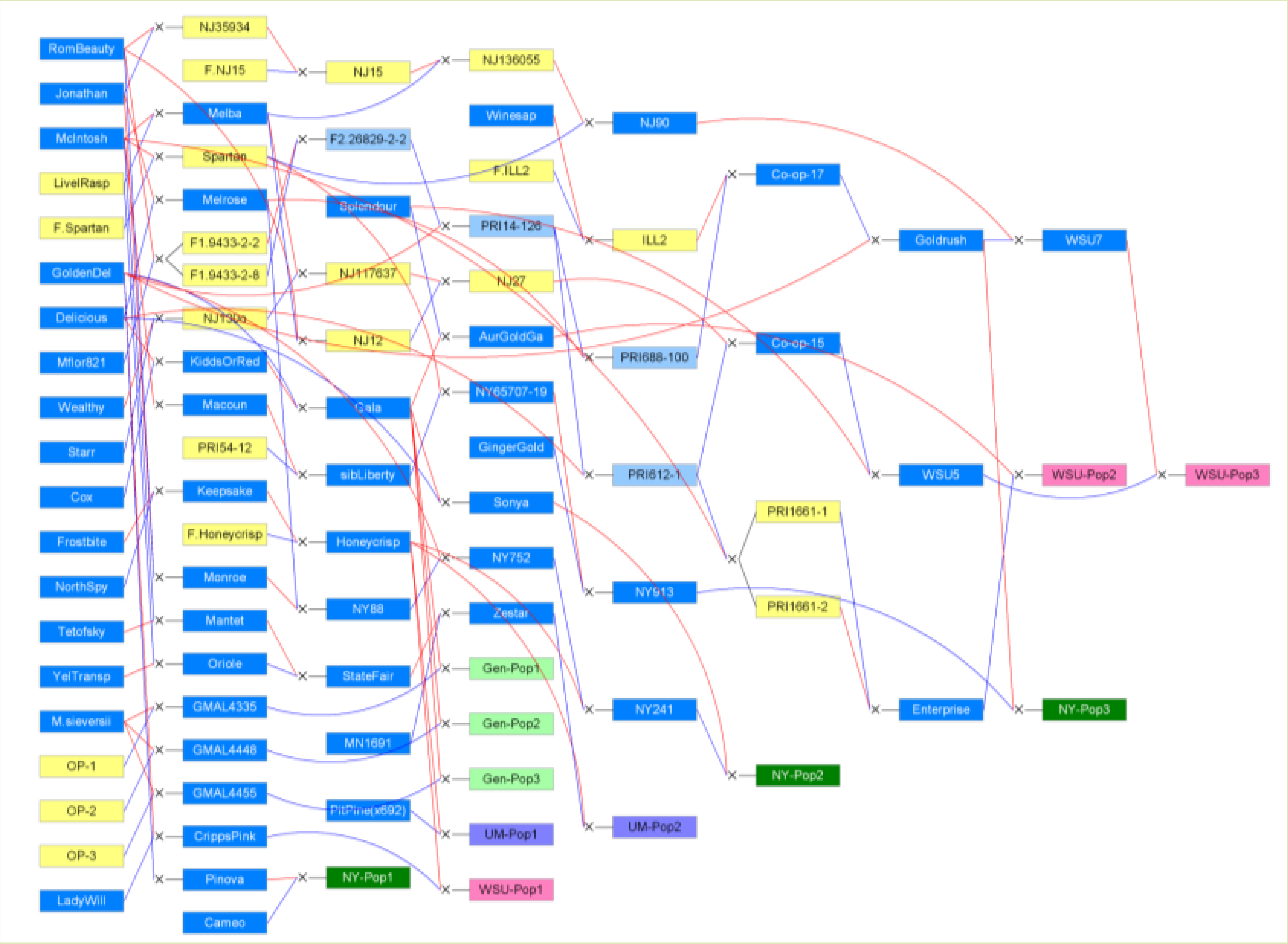
Common challenges.

1. Heterozygosity

2. Polyploidy (4x and 8x)

3. Long generation time

Pedigrees of apple breeding populations



RosBREED OBJECTIVES

1) Use knowledge of trait values to enhance new cultivar adoption, enlarge market potential, and increase consumption.
2) Establish sustainable infrastructure for marker-assisted breeding (MAB).
3) Integrate breeding and genomics information.
4) Conduct MAB in core breeding programs.
5) Enhance sustainability of cultivar development through stakeholder education.

Project Goals: Extension

- RosBREED demonstration breeders and project associates are being be trained to optimize utilization of marker-assisted breeding (MAB) and knowledge of trait values.

- Successful adoption of MAB will be enhanced by cross-communication and cross-disciplinary collaboration with allied scientists.

- Stakeholders will appreciate how the use of genomics information can be harnessed to develop new varieties that meet market needs and consumer preferences.

Trait Impact: Focus on fruit quality

Target trait selection: utilize improved knowledge of industry value & consumer preferences.

Are red fleshed peaches & nectarines high priority breeding targets?
Would this fruit type have value in the marketplace?
What is the economic weight for this fruit color trait?

Photos courtesy of Dr. Byrne (nectarine & peach)

Trait and Market Class Breeding Target Establishment

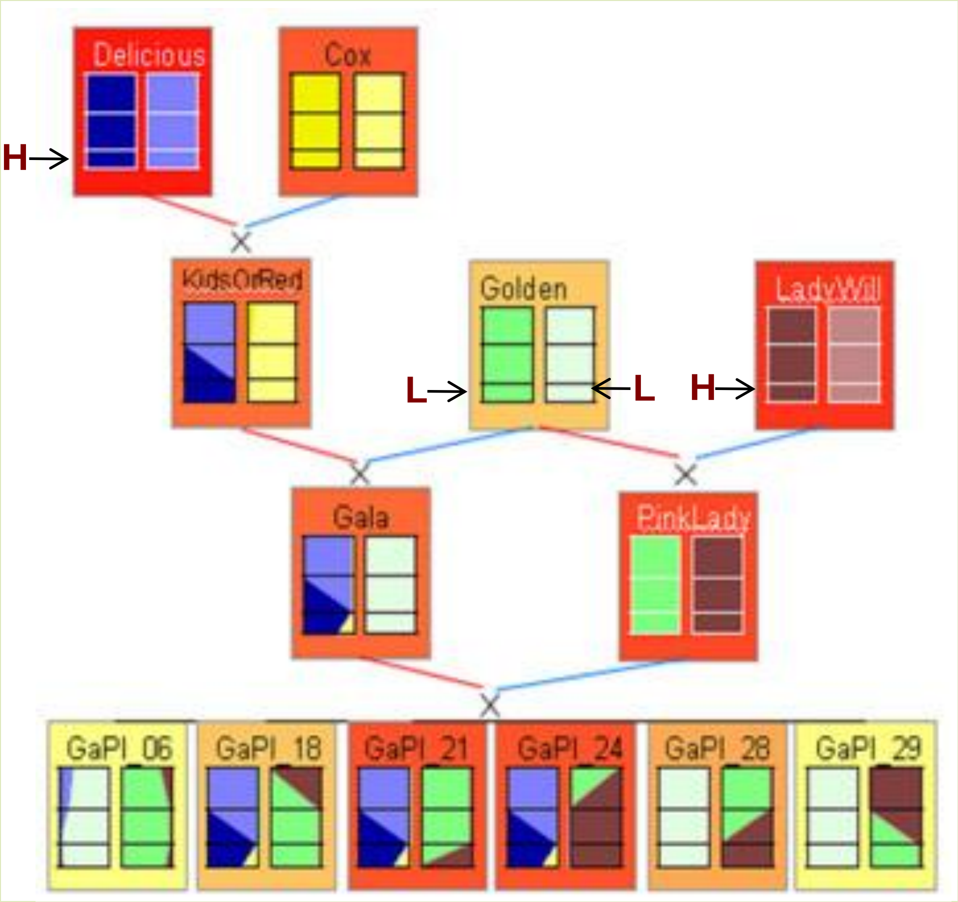
Use knowledge of trait values & preferences from

producers, processors, & consumers

to prioritize breeder targets so that new cultivars will be more quickly accepted and have an enhanced commercial and consumer impact.

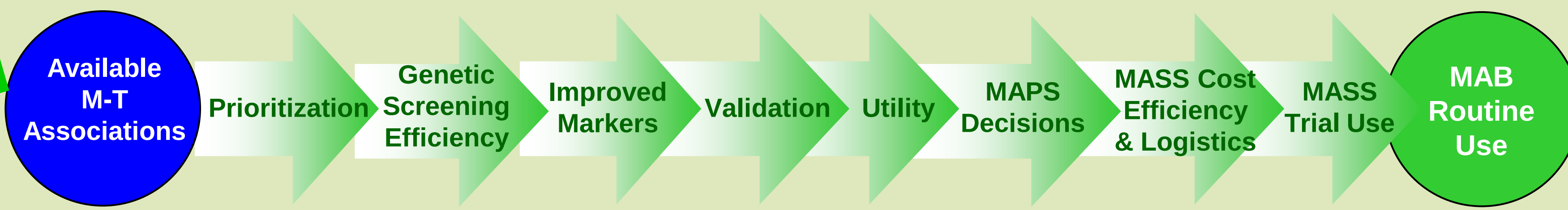
Pedigree Based Analysis

Pedigree, trait, and genotypic information for six apple seedlings, identifying a marker-trait association for skin blush on apple chromosome 9.



MAB Pipeline Implementation

- Put MAB Pipeline into practice
- Demonstrate MAB with high-impact targets
- Achieve routine MAB by core breeding programs
- Technology transfer to all interested U.S. Rosaceae breeders



→ Routine marker-assisted breeding for U.S. Rosaceae

RosBREED demonstration breeders and project associates are being be trained to optimize utilization of marker-assisted breeding (MAB) and knowledge of trait values.

RosBREED Breeding Trainees

Training at a statistical workshop
(June 2010)

Evaluation of Extension Impact

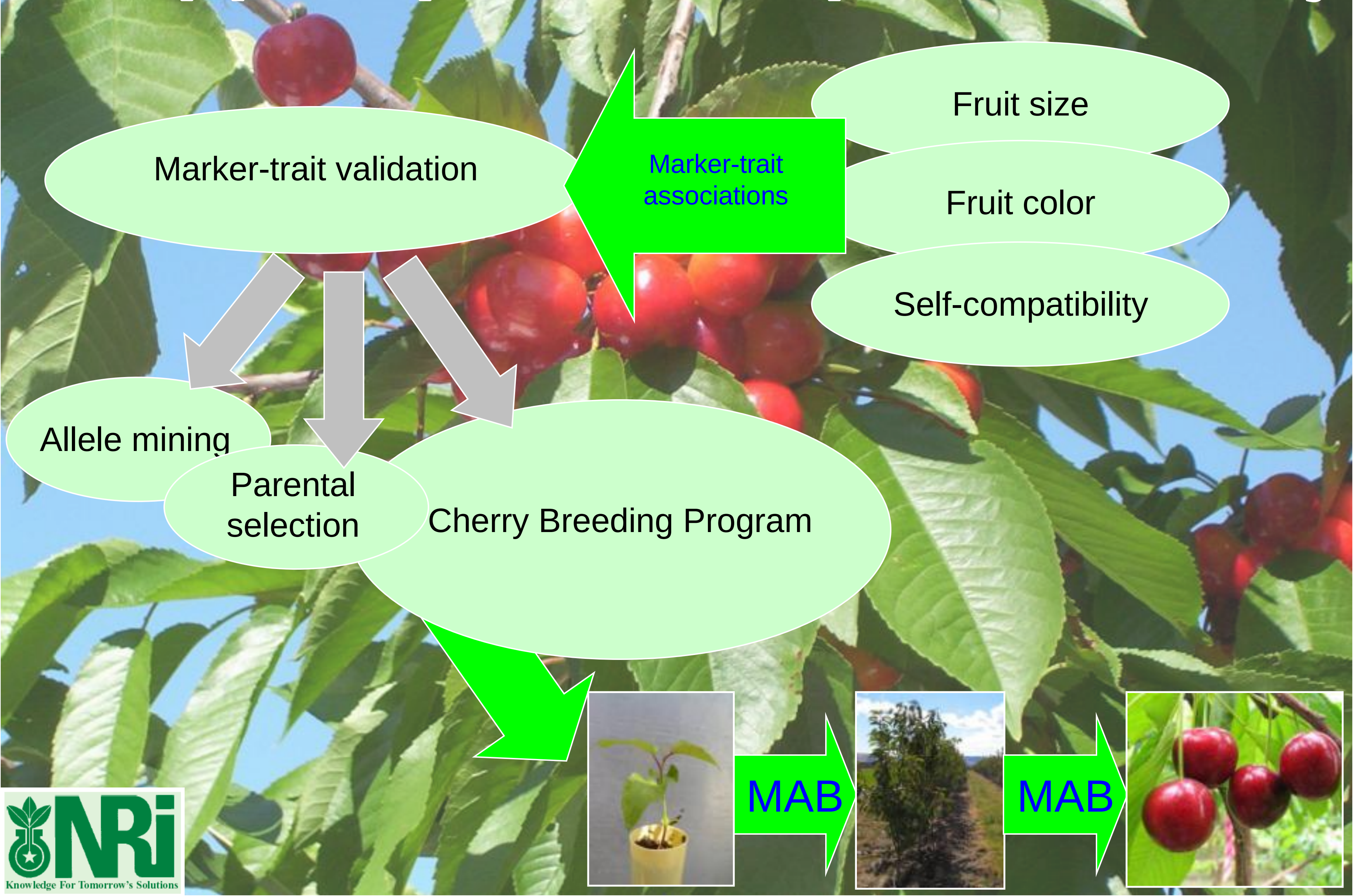
Michael Coe

1. Breeders & Allied Scientists (2010: baseline survey and interviews)

2. Producers/Processors, Marketing Groups, Trade Organizations (2010: baseline survey)

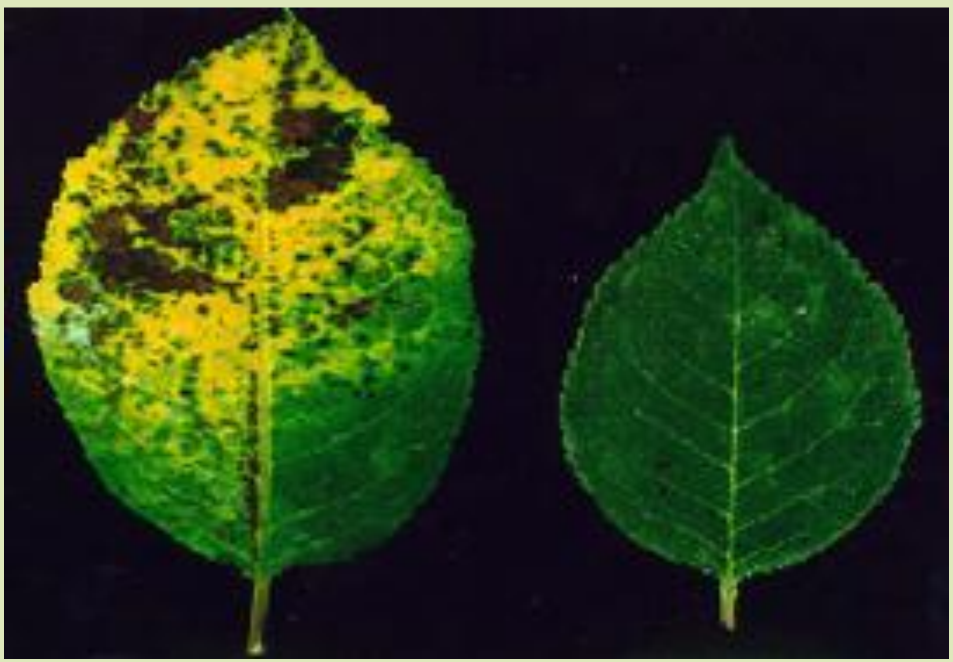
3. Graduate Students (baseline survey at beginning of traineeship)

MAB pipeline proof of concept in sweet cherry

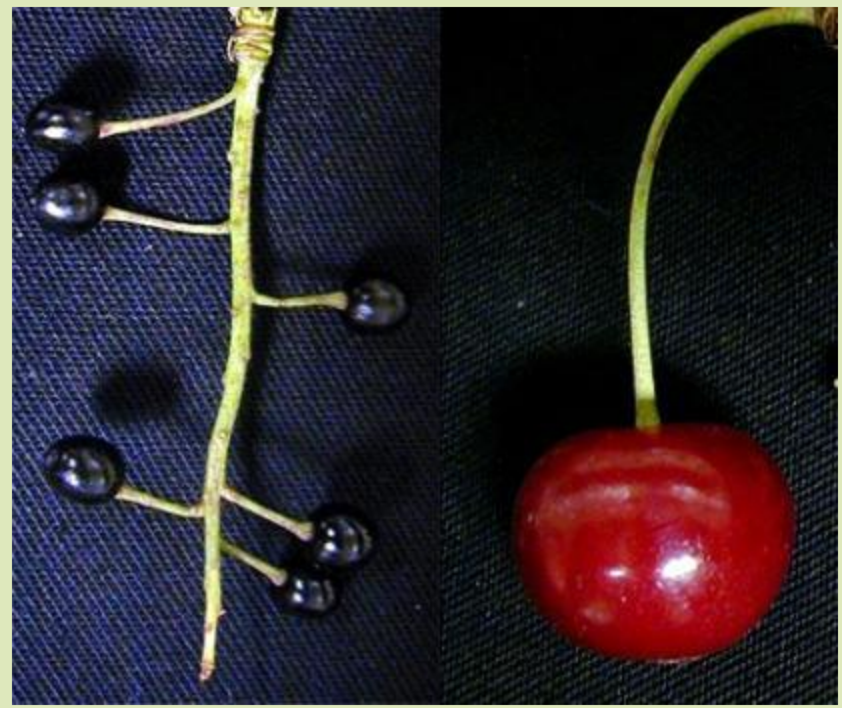


How will RosBREED help me breed cherry leaf spot resistant tart cherry cultivars?

Susceptible **Resistant**



Resistant **Susceptible**



RosBREED will generate knowledge of the genetic control of fruit size & enable the use of this information to more efficiently achieve the desired fruit size while retaining the CLS resistance.

Sweet cherry cultivar

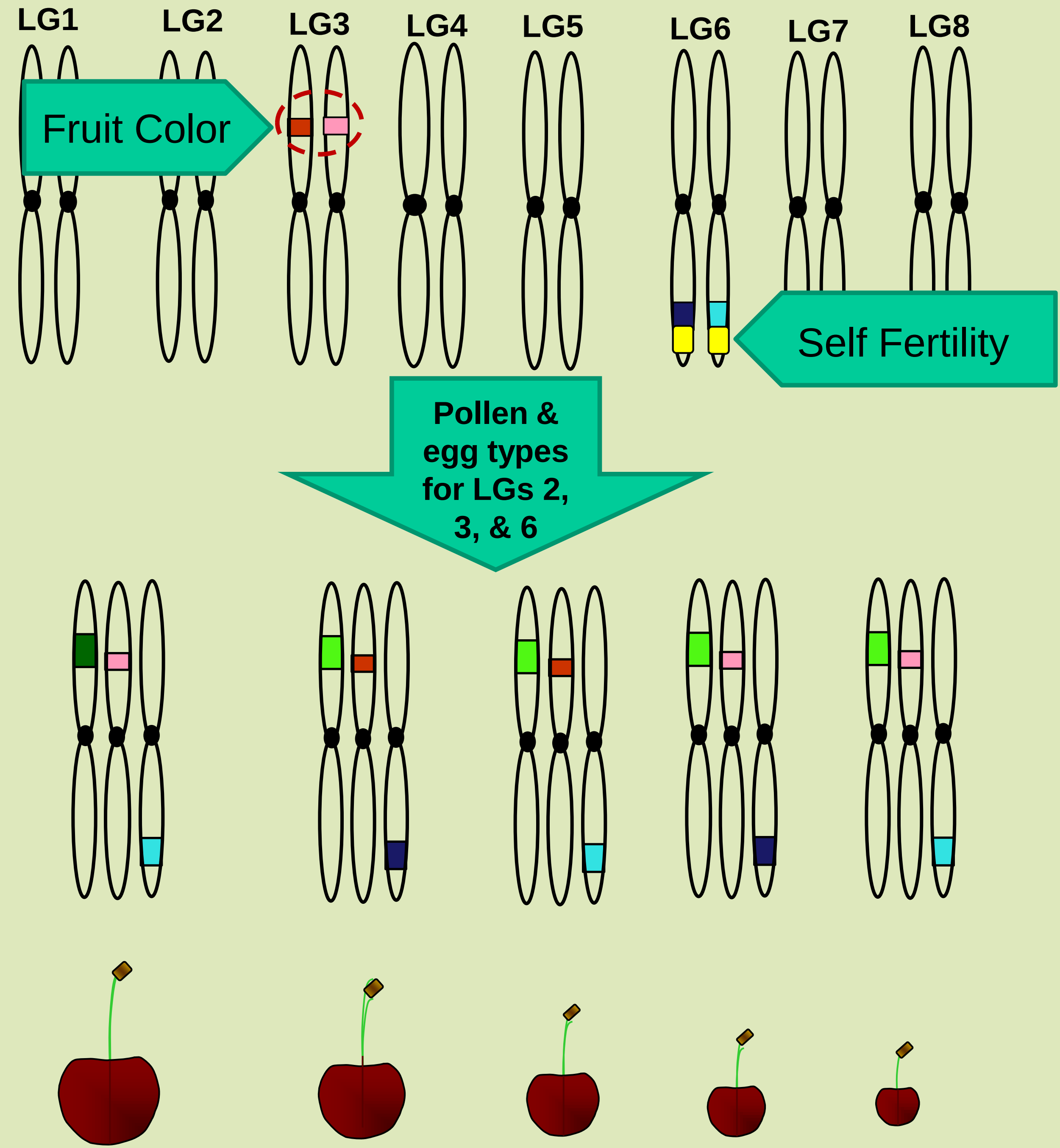
12 grams

2 grams

Wild forest cherry

We are identifying the genetic changes that are responsible for this increase in fruit size.

In sweet cherry, 3 linkage group regions have been identified that contain genes that control fruit size.



Marker-Assisted Breeding Outcomes

Four year project outcomes

Increased genetic knowledge flow across taxonomic boundaries in the Rosaceae

Implementation of MAB by breeding programs

Increased gain in fruit quality per breeding cycle due to improved parent selection and improved mean progeny value

Long-term outcomes

More rapid availability of new cultivars with genetically superior fruit quality

Improved profitability and sustainability of US rosaceous fruit, nut, and floral crops with increased consumption and enjoyment

RosBREED Advisory Panels

SCIENTIFIC

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Joe Arvai
Fred Bliss
Robin Buell
Lailiang Cheng
Sue Gardiner
Carolyn Ross
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RosBREED

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Acknowledgements

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RosBREED

A special Thank You to ……

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Joan Schneider

Audrey Sebolt

Questions?