RosBREED

Enabling marker-assisted breeding in Rosaceae

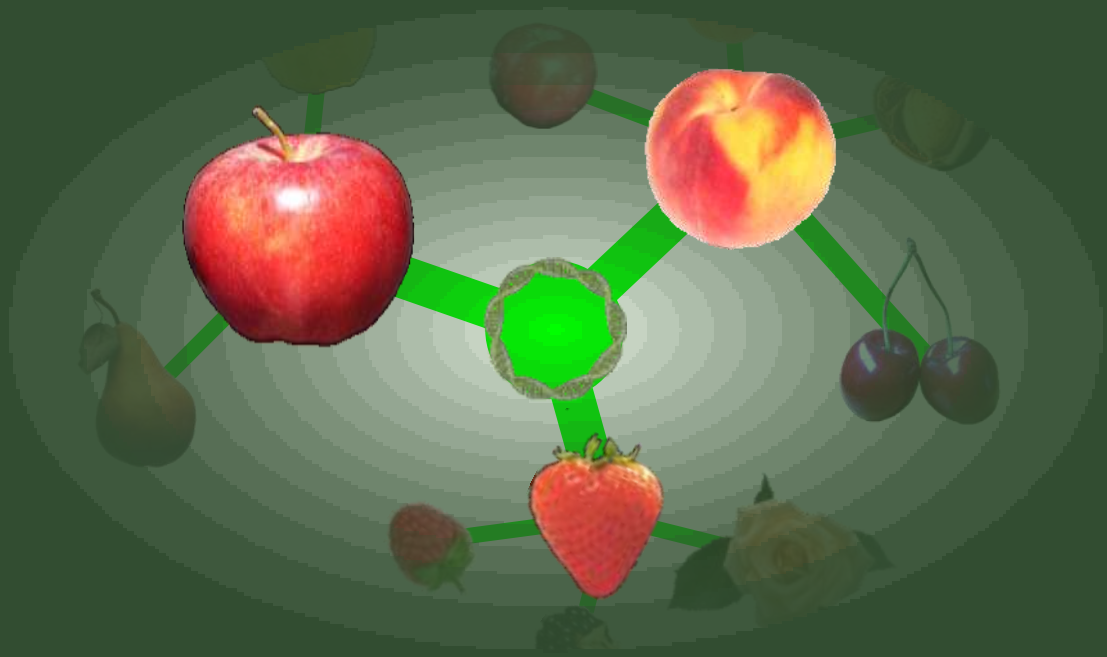
Breeding fruit crops in the USA using socio-economic and DNA information

Jim McFerson, Nahla Bassil, Marco Bink, Susan Brown, David Byrne, John Clark, Carlos Crisosto, Tom Davis, Kate Evans, Gennaro Fazio, Chad Finn, Karina Gallardo, Ksenija Gasic, Tom Gradziel, James Hancock, Raymond Jussaume, James Luby, Dorrie Main, Vicki McCracken, Nnadozie Oraguzie, Cameron Peace, Gregory Reighard, Alexandra Stone, Mykel Taylor, Dechun Wang, Cholani Weebadde, Eric van de Weg Kenong Xu, Chengyan Yue, Amy Iezzoni

S11 ISAFRUIT
IHC LISBOA 26 Aug 2010

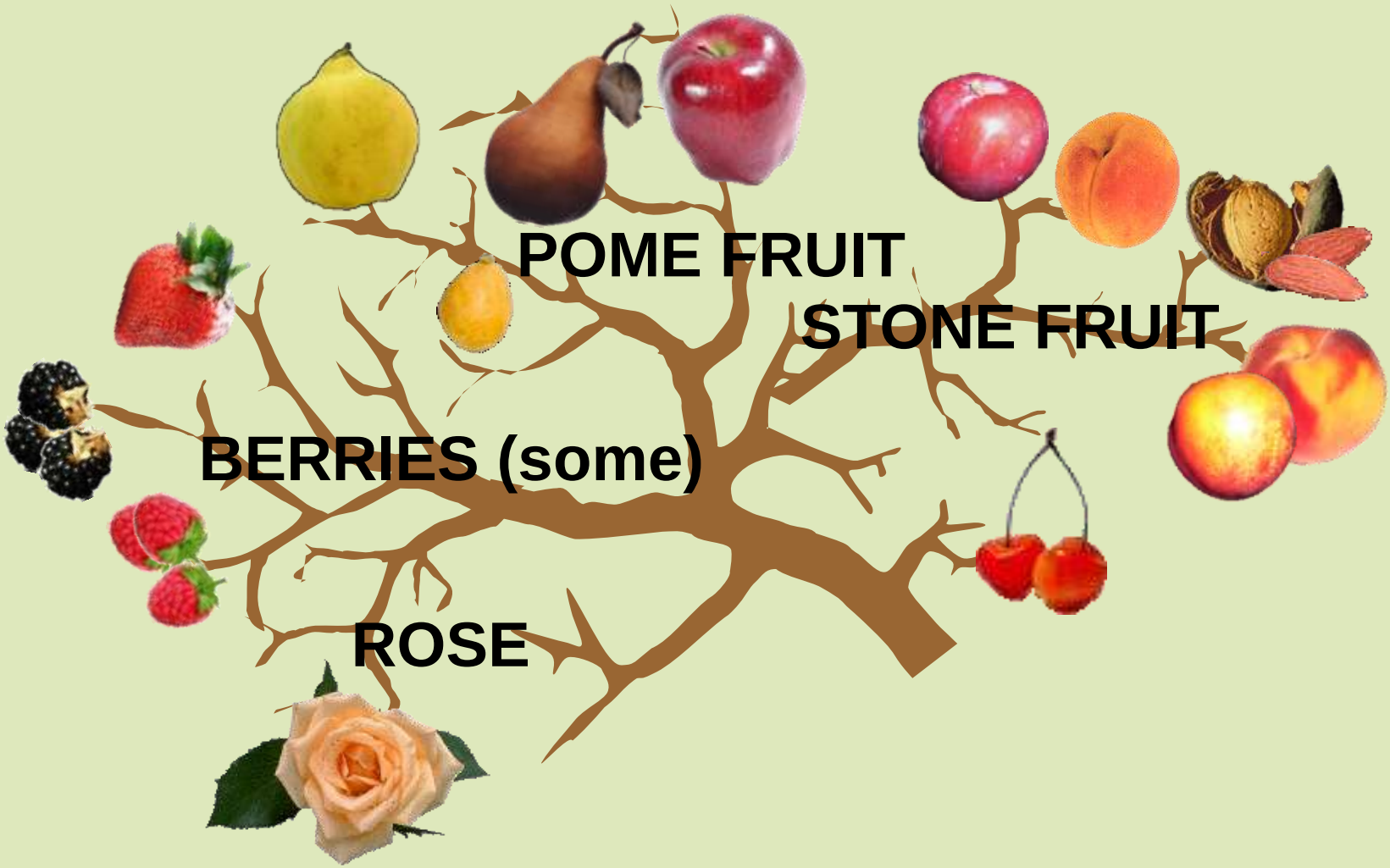
Outline

- RosBREED background
- Preliminary results
  - Breeder survey
  - Target traits
  - Marker assisted technology
  - Relative importance of traits for five crops
- Conclusions



RosBREED Background

The Rosaceae family of horticultural crops.



OUR DREAM

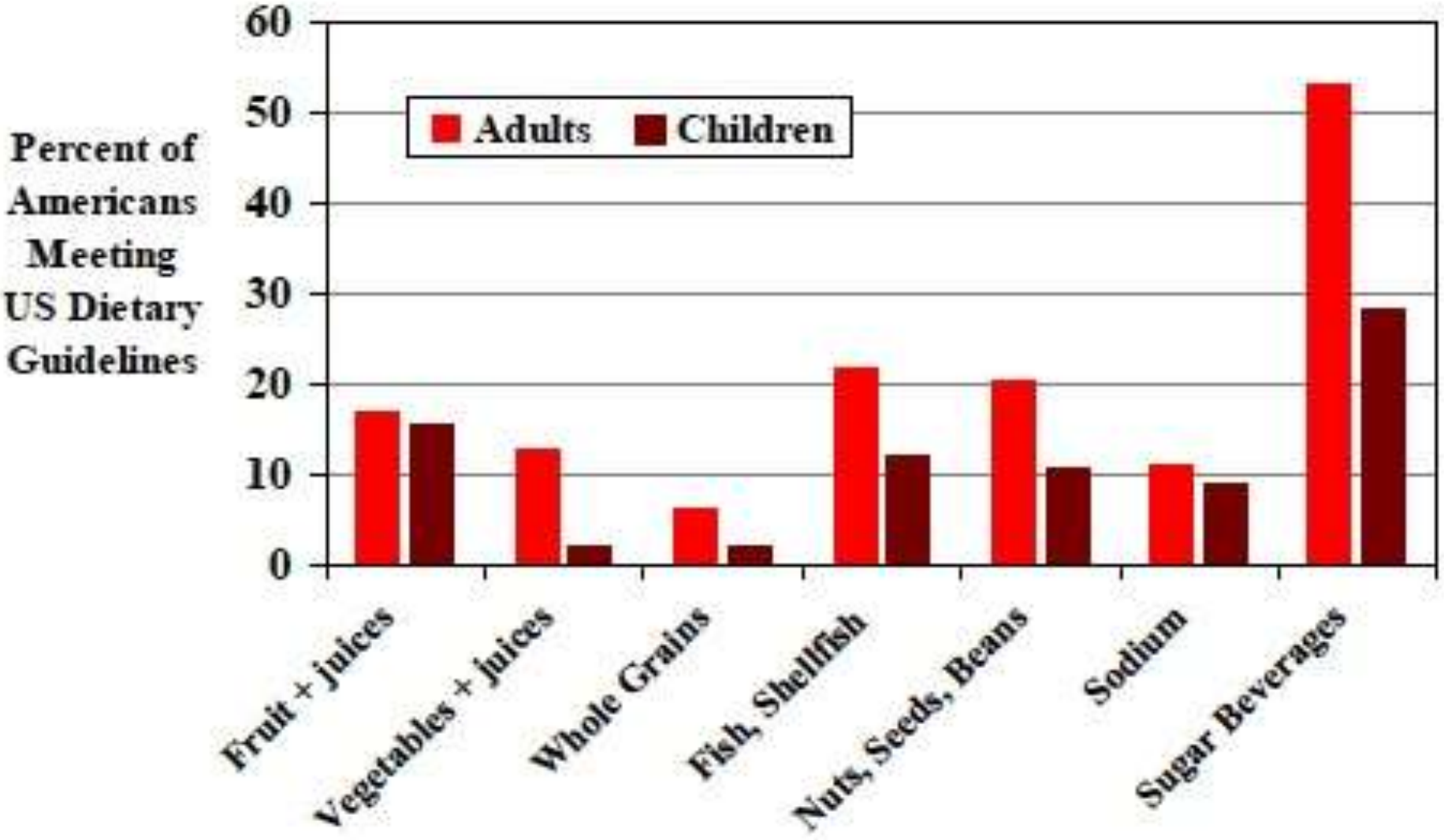
Ultra-crisp tasty apples
sweet juicy peaches
flavorful cherries
luscious strawberries

Consistent quality, available & affordable

Enjoyed by consumers, regularly

Sustainably produced throughout the U.S.

Percent of Americans Meeting Diet Guidelines



Based on NHANES 2005-06; Mozaffarian et al., in preparation


Producers

IMPACT

increase new cultivar adoption

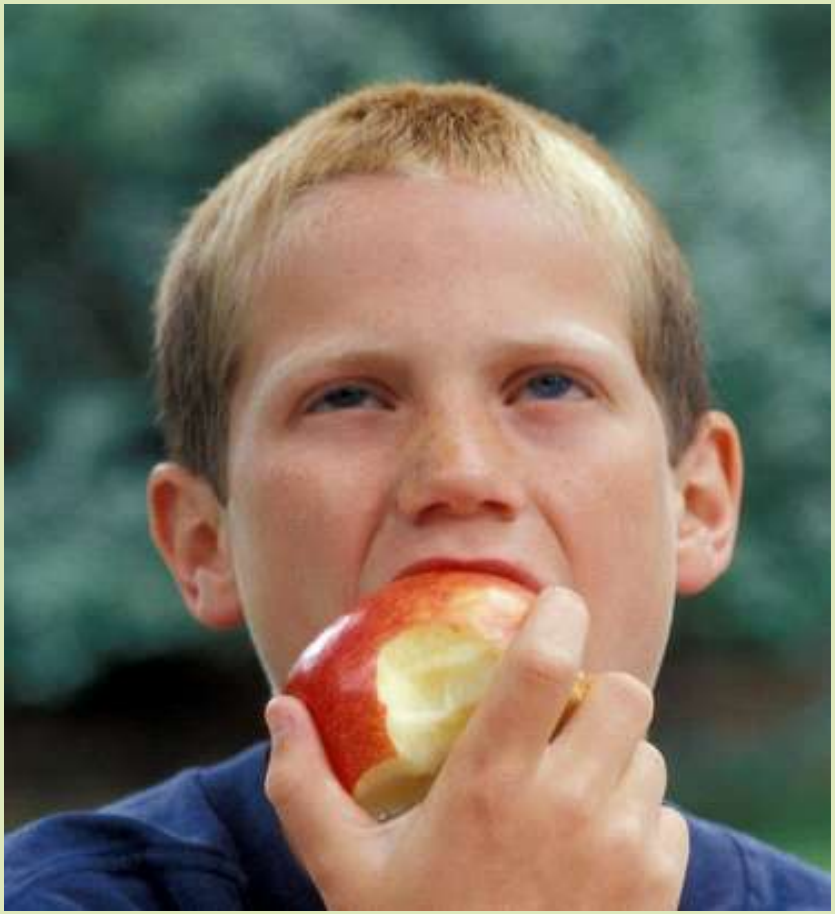
enlarge market potential

increase consumption

Focus on fruit quality

Honeycrisp: a breakthrough cultivar

- Introduced 1991, Univ of Minn.
- Dramatic impact in U.S. market
- Unique ultra-crisp juicy texture and pleasing flavor
- *Required 30 years from crossing to commercialization*
- **RosBREED can help develop such cvs using DNA and Socio-economic information**



MISSION STATEMENT

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

Amy Iezzoni, Michigan State Univ
Cameron Peace, WA State Univ

4 yrs
$7.2M federal
$7.2M matching

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

This project is supported by the Specialty Crops Research Initiative of USDA's National Institute of Food and Agriculture

RosBREED
Enabling marker-assisted breeding in Rosaceae

www.rosbreed.org

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 demonstration breeding programs.

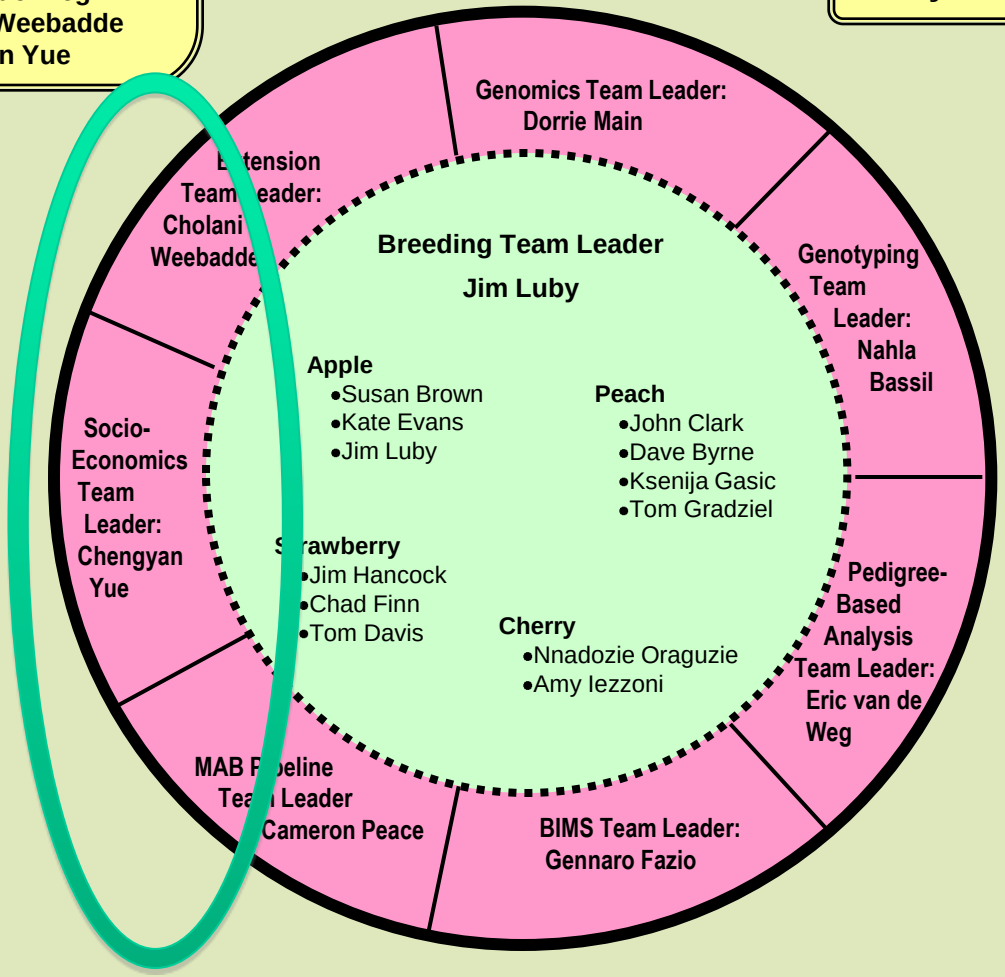
5) Enhance sustainability of cultivar development through stakeholder outreach and education

RosBREED Organization

Executive Committee
- Cameron Peace
- Nahla Bassil
- Gennaro Fazio
- Jim Luby
- Dorrie Main
- Jim McFerson
- Eric van de Weg
- Cholani Weebadde
- Chengyan Yue

Project Director
Amy Iezzoni

Project Assistant



Co-PIs
29

Organizations
11

Intl partners
7

Advisory panels
39

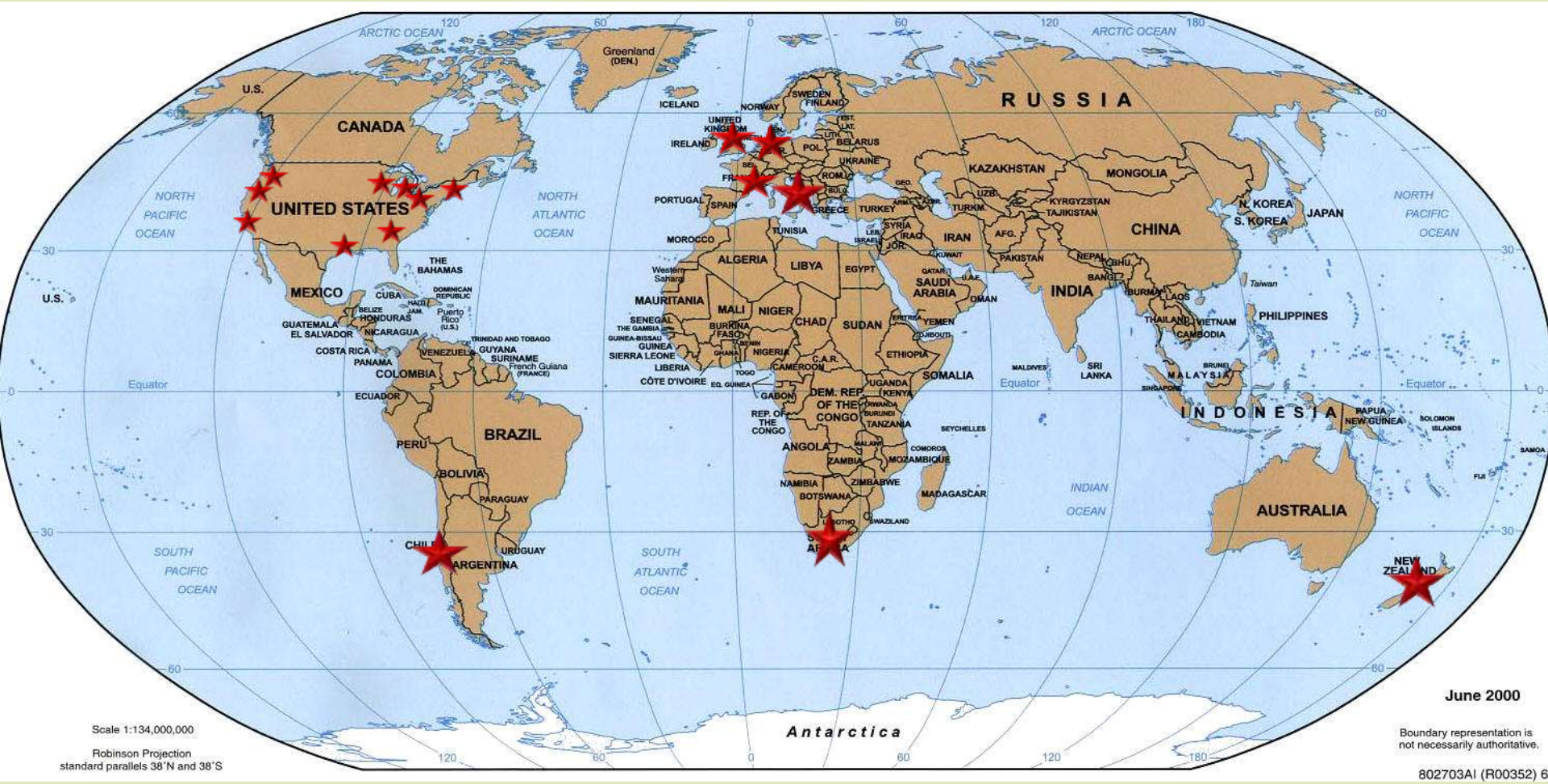
RosBREED Participants

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

Supported by the Specialty Crops Research Initiative of USDA's National Institute of Food and Agriculture

NIFA

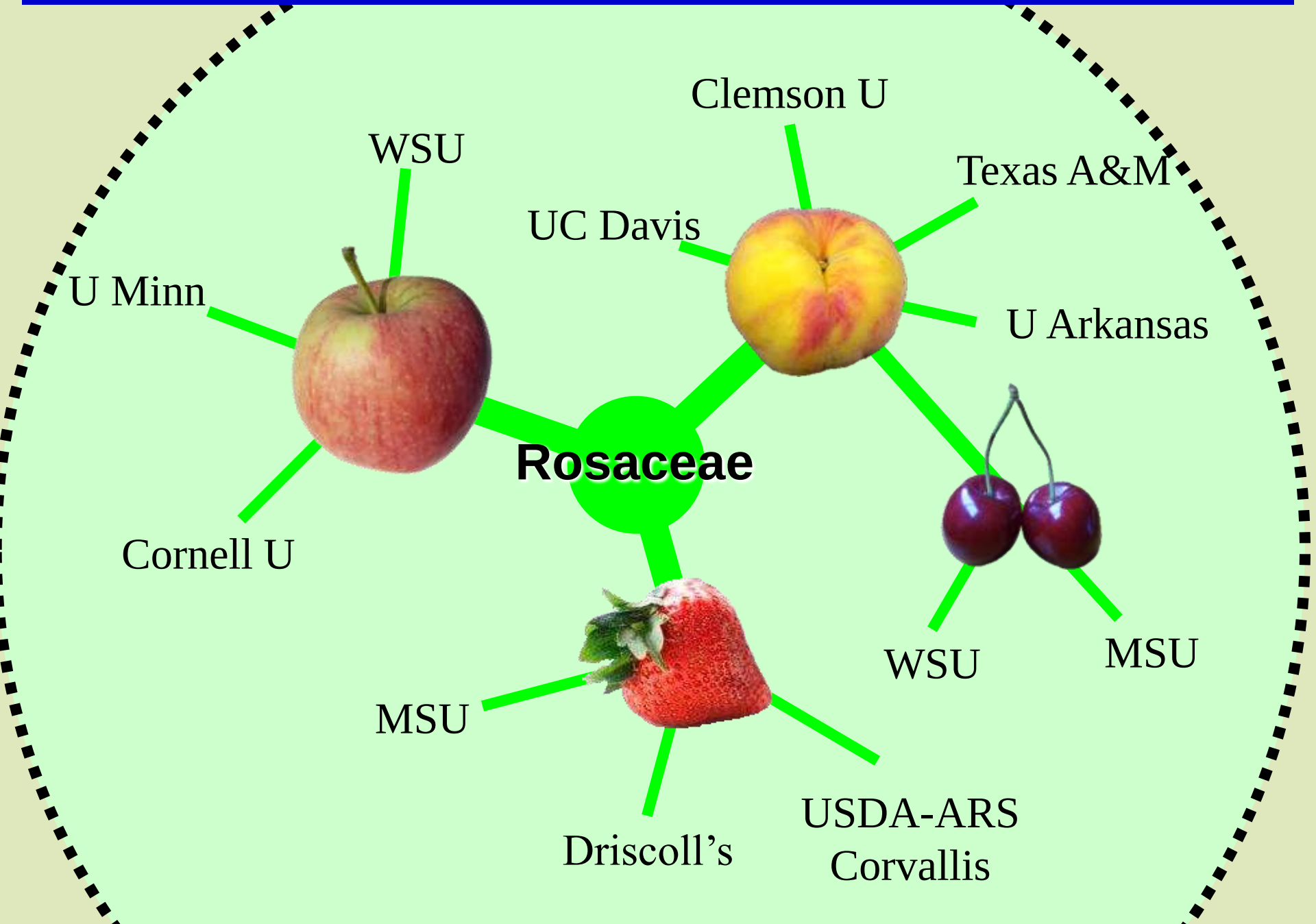
RosBREED International Partners



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

Andres Bello University
University of the Western Cape
Plant & Food Research
FruitBreedomics

RosBREED DEMONSTRATION BREEDING PROGRAMS



Trait and Market Class Breeding Targets

Use knowledge of trait values & preferences from

producers, processors, & consumers

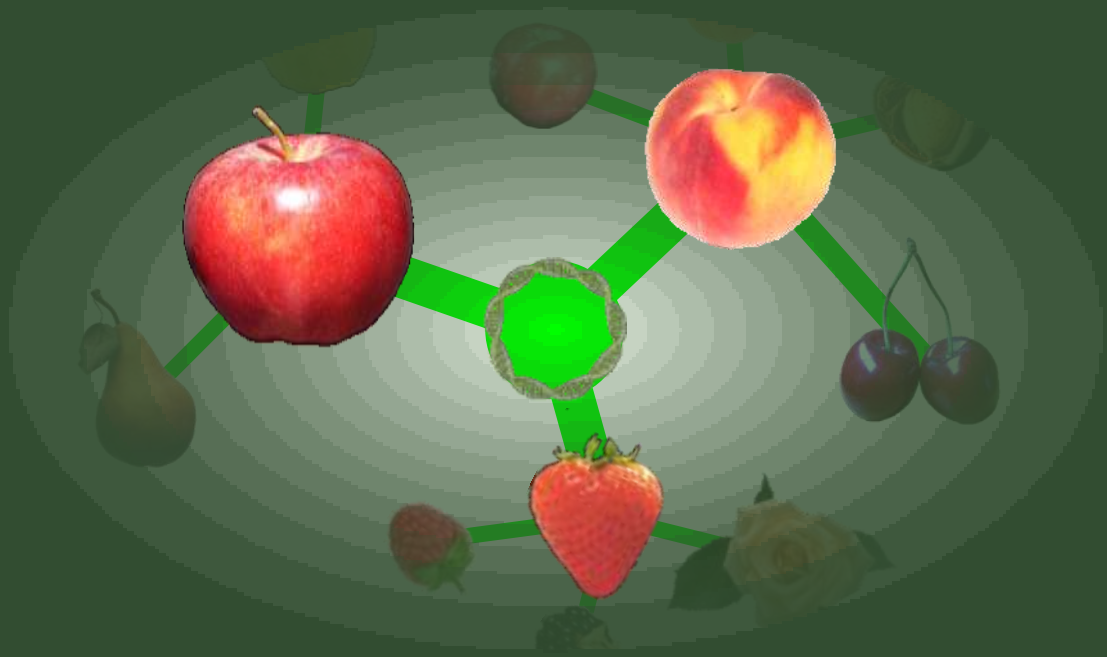
to prioritize breeder targets so new cultivars will be more quickly accepted and have enhanced commercial and consumer impact.

Trait Impact: Focus on fruit quality

Utilize improved knowledge of industry value & consumer preferences to target traits

Red fleshed peaches & nectarines: high priority breeding targets?
Value in the marketplace?
Economic weight for this fruit color trait?

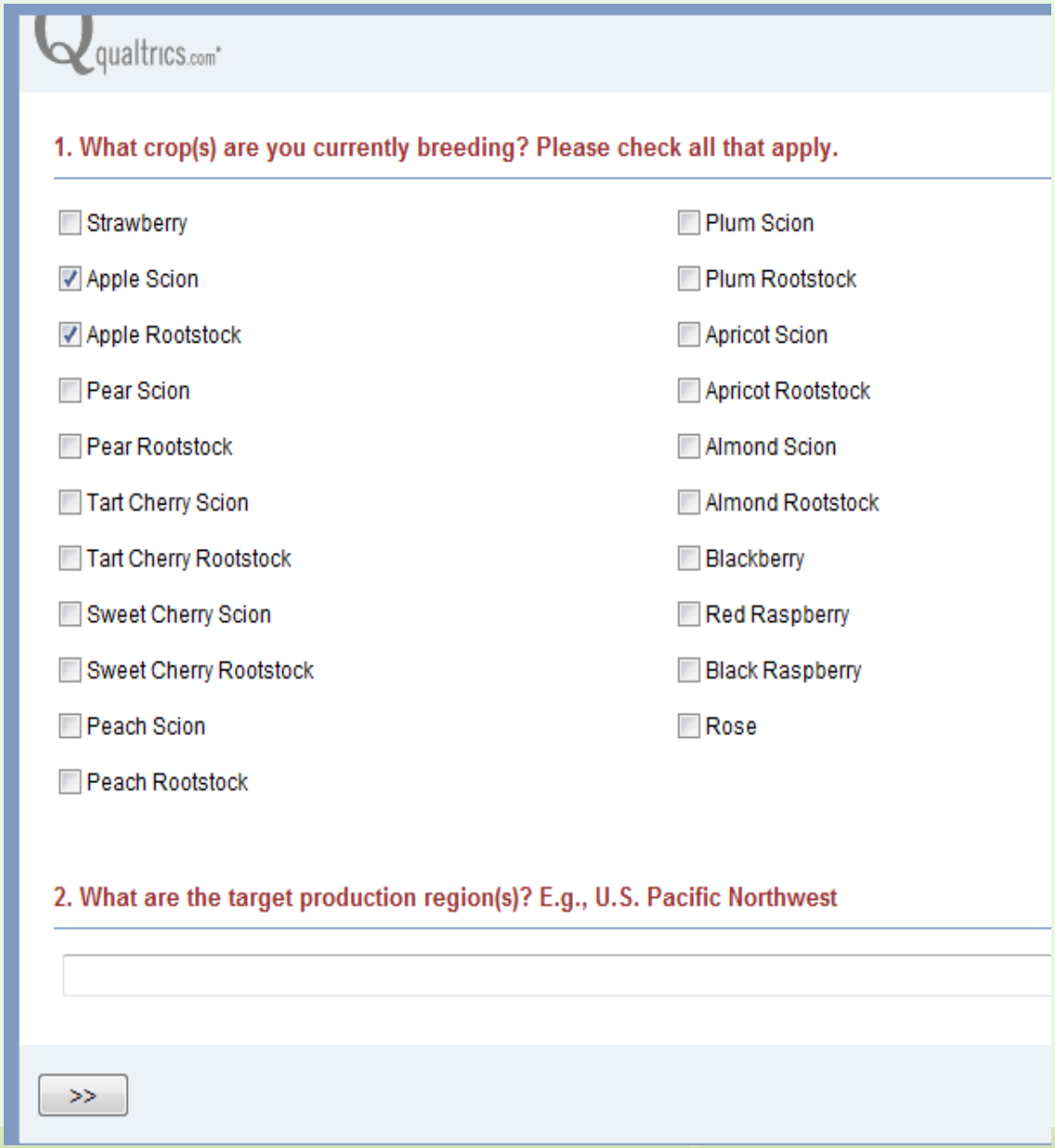
Courtesy David Byrne, Texas A&M Univ.)



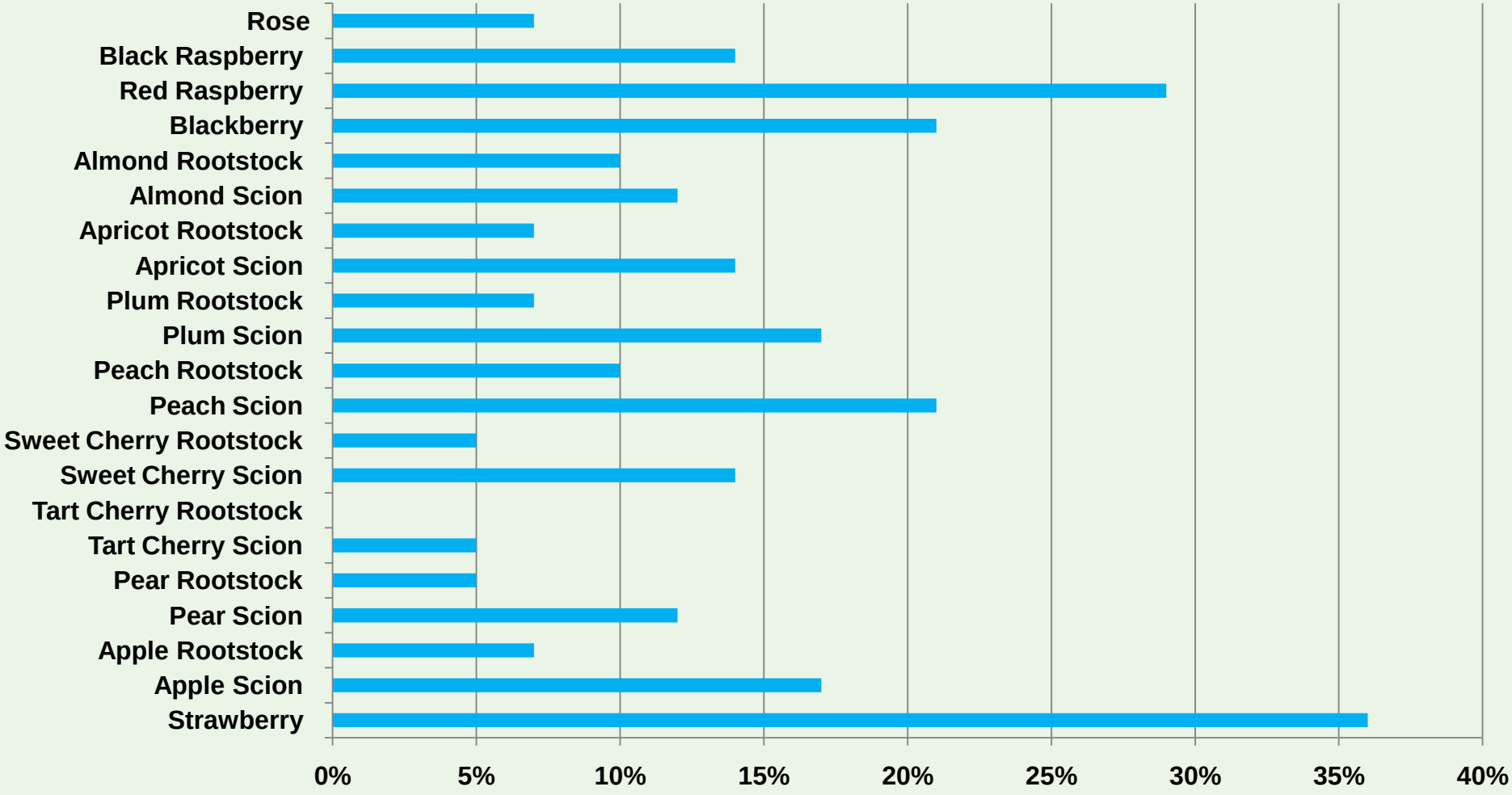
Initial Socio-economics results

Breeder Web Survey

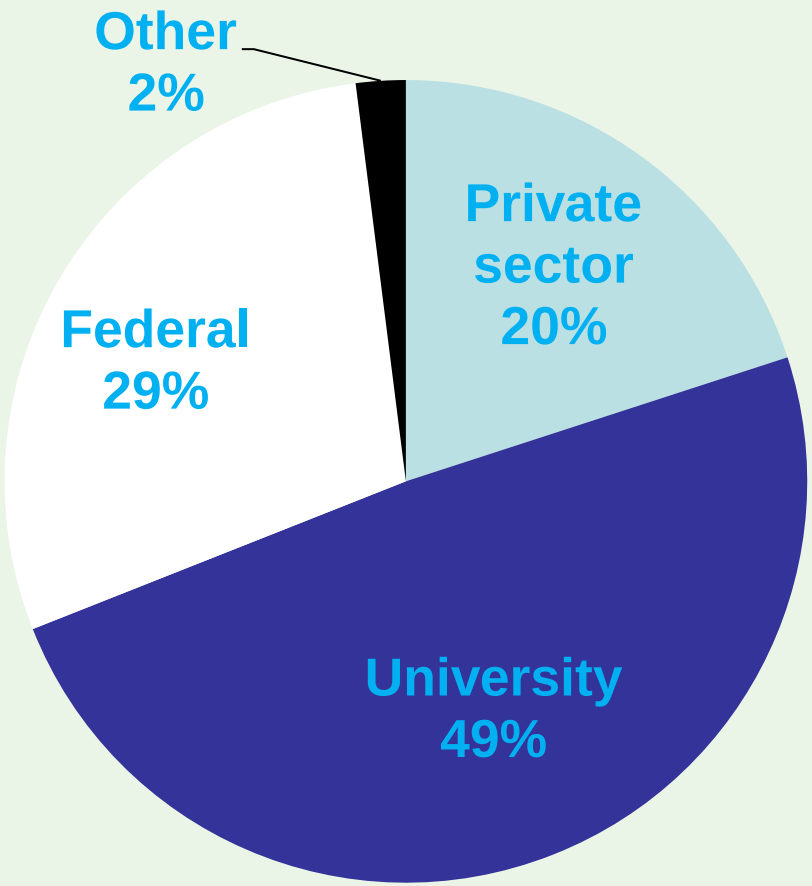
Rosaceae breeders: USA and Canada	60
Responses	41
Usable responses	39



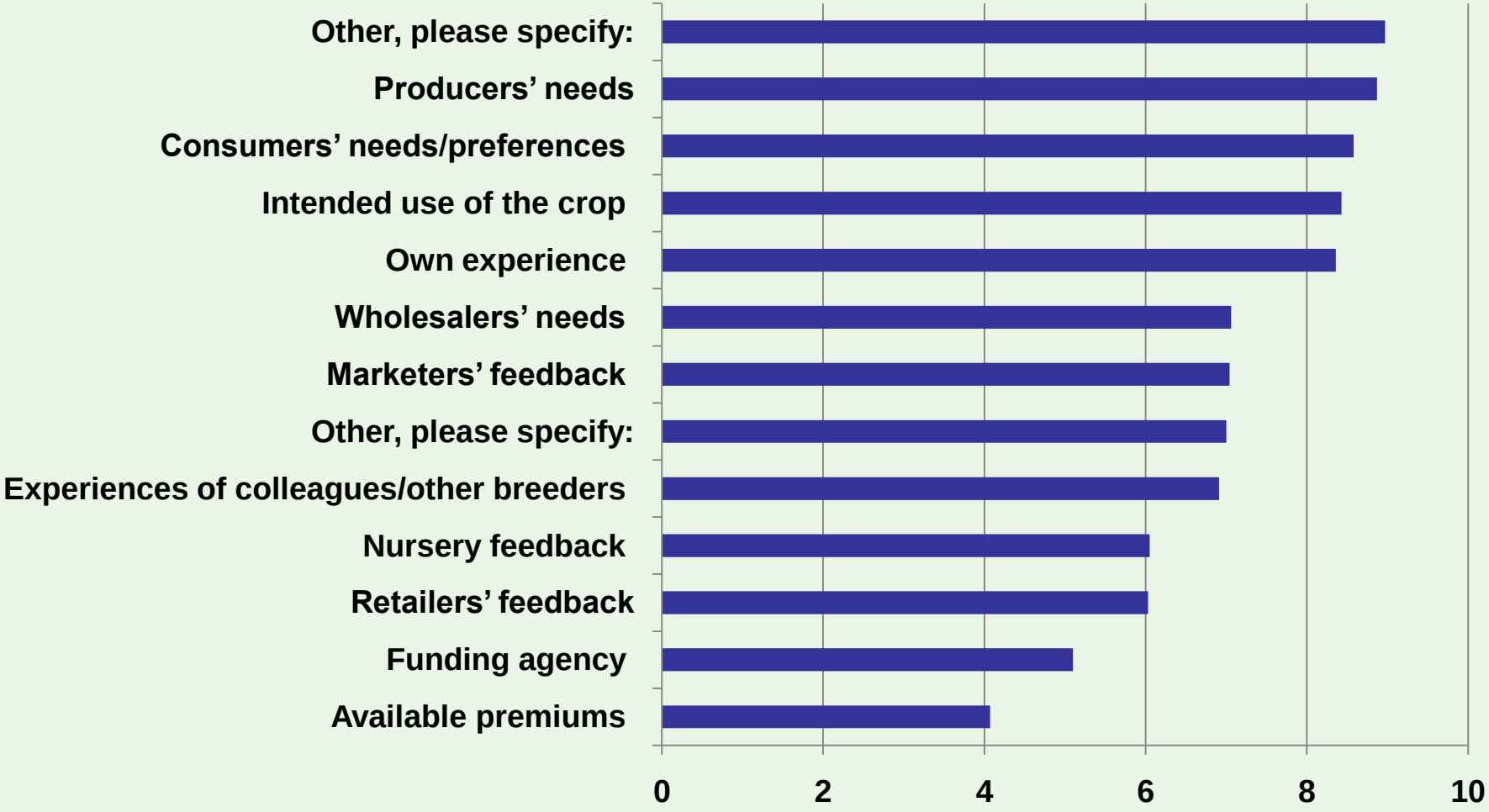
Target crop(s)



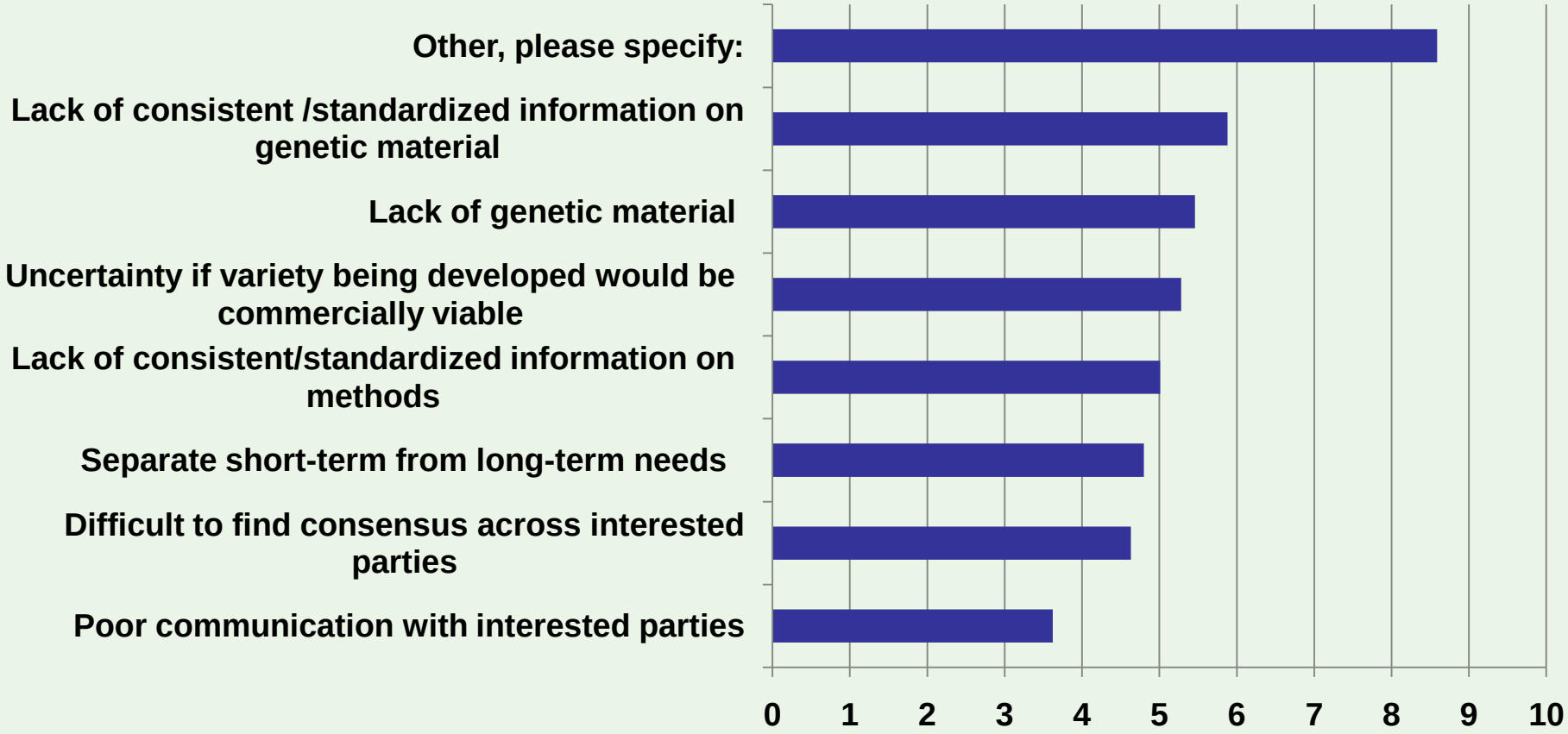
What type of organization are you working at as a breeder?



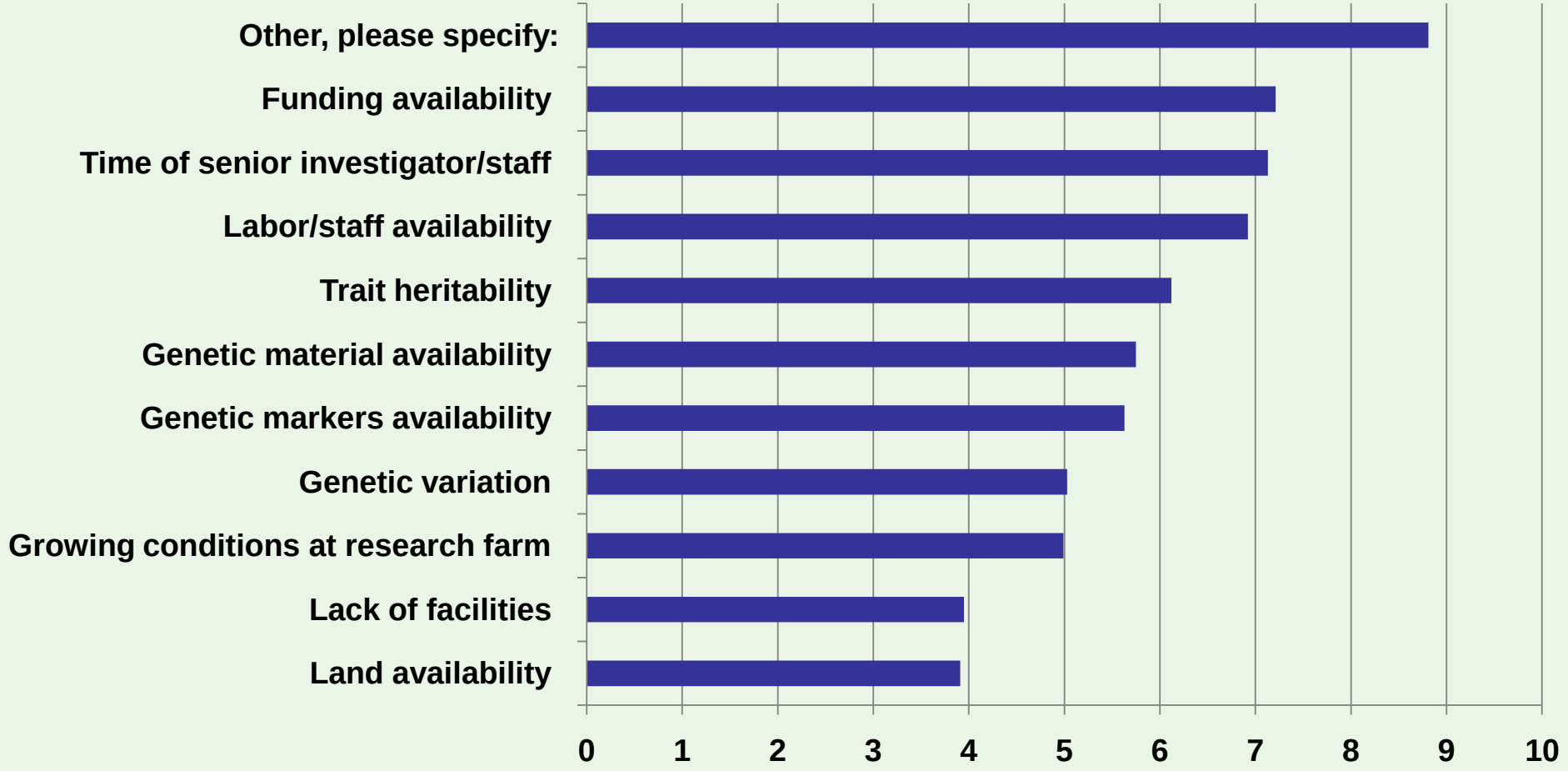
Influence of interested parties (1-10 scale, mean value)

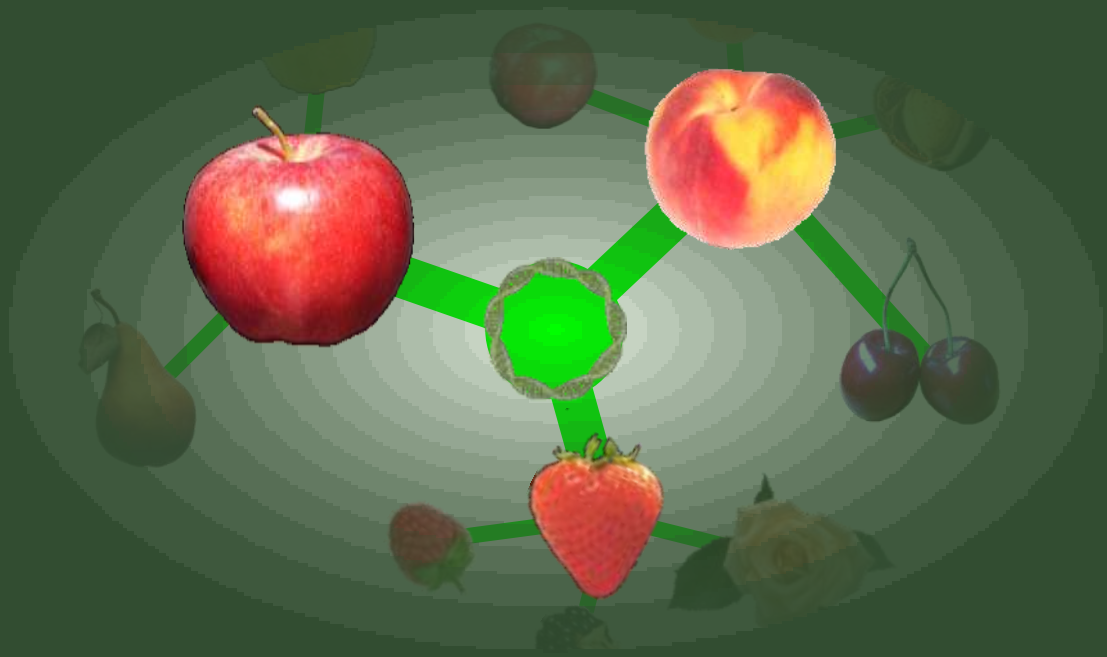


Challenges in determining priorities
(1-10 scale, mean value)



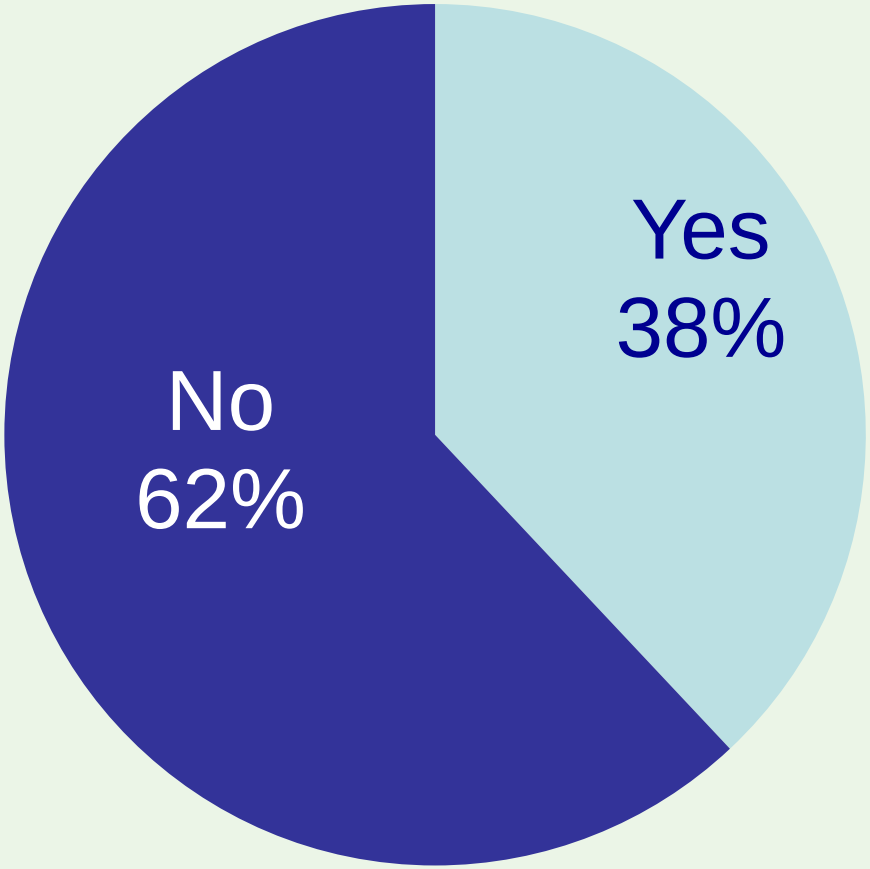
Challenges in implementing priorities
(1-10 scale, mean value)



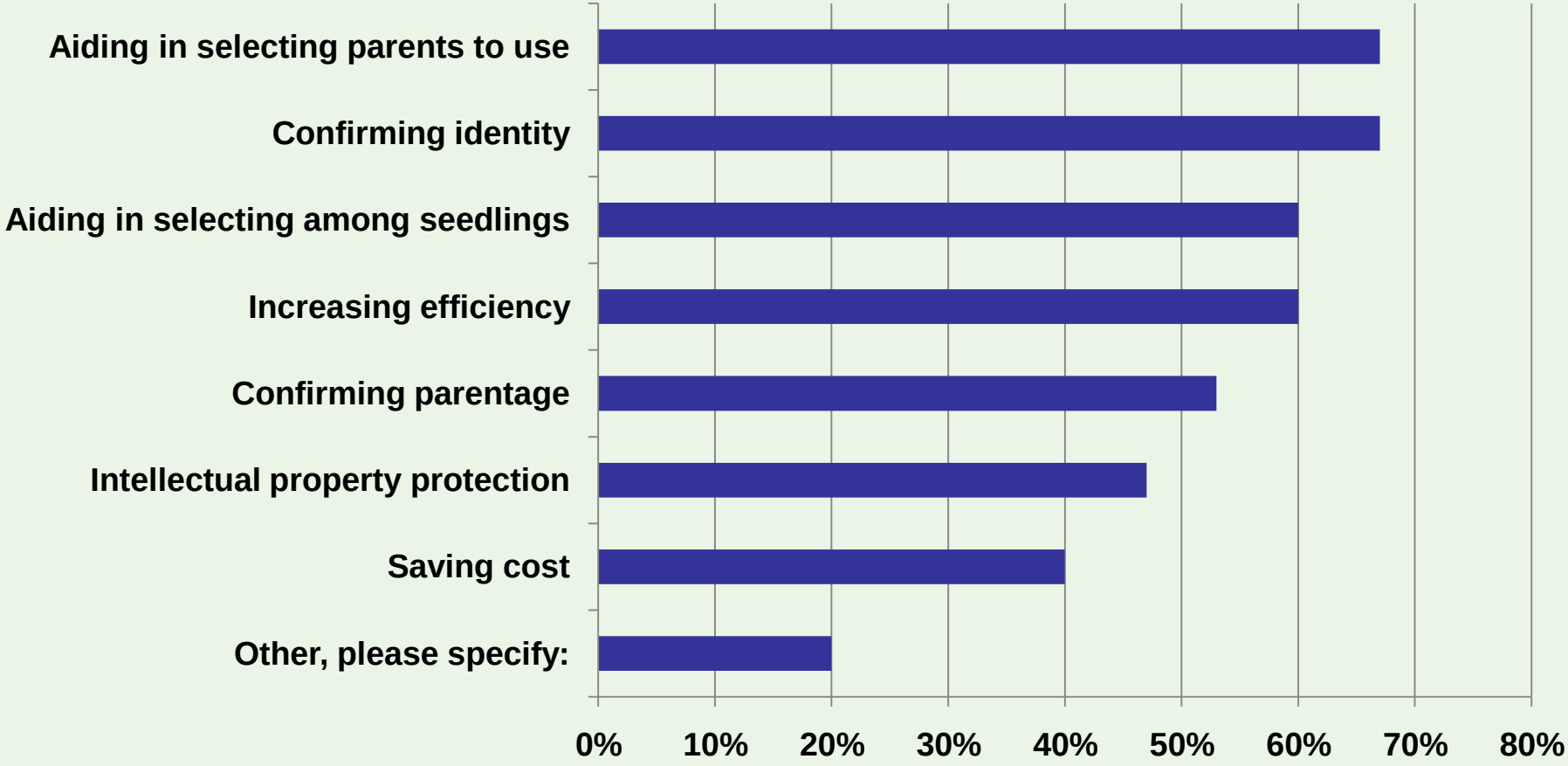


Marker Assisted Technology

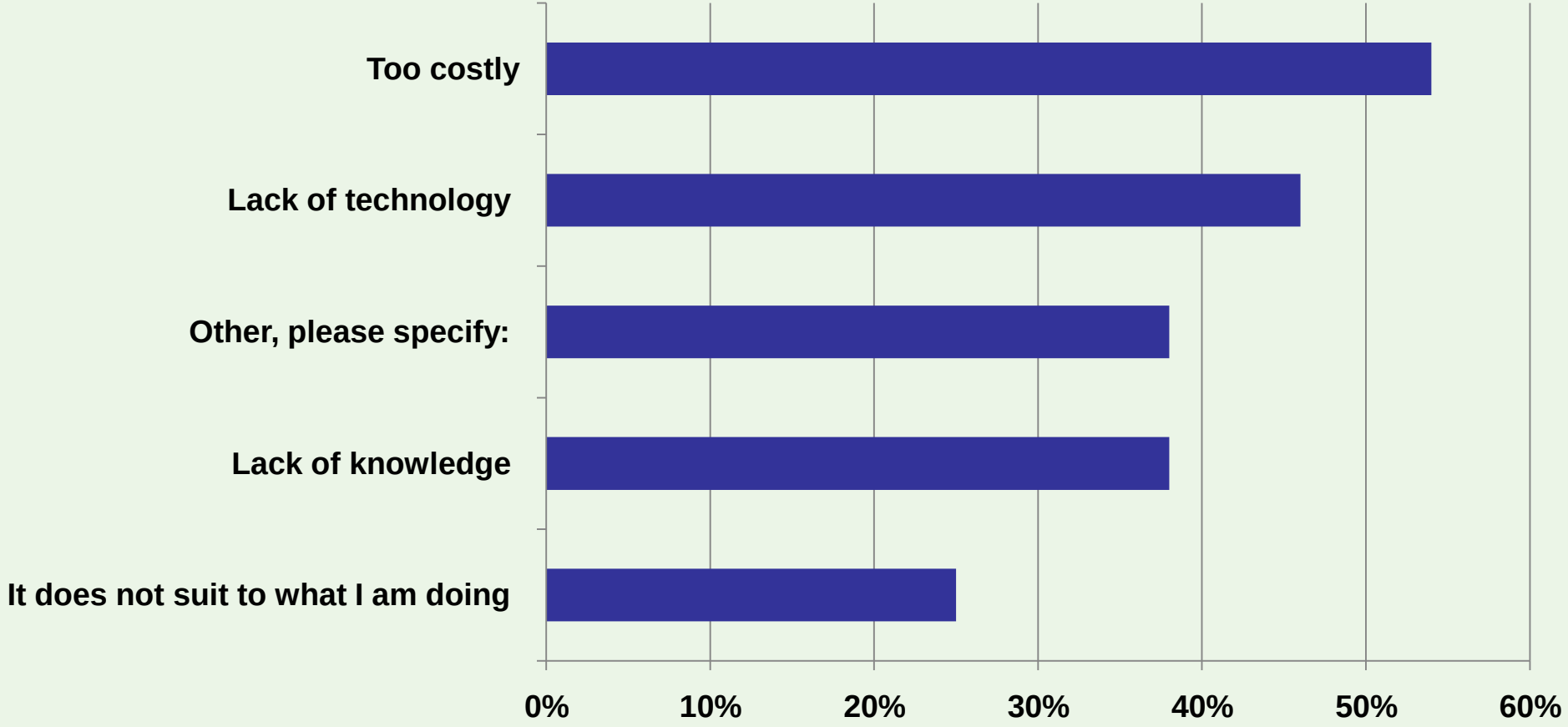
Use marker assisted technology

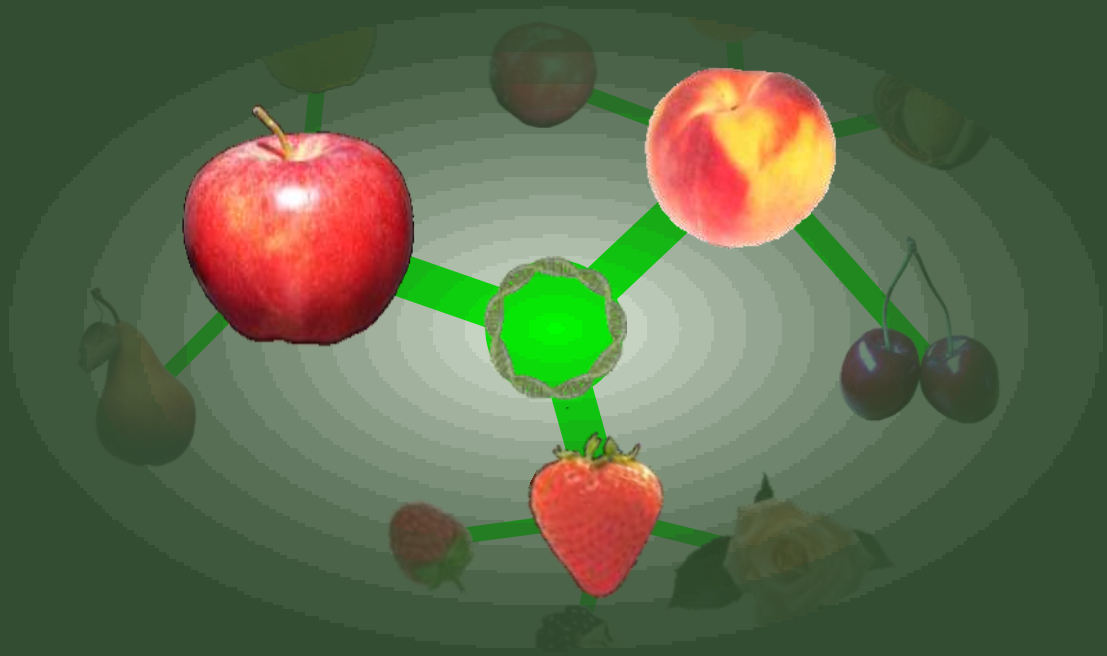


Reason for using marker-assisted technology



Reason for NOT using marker-assisted technology





Relative Importance of Genetic Traits for Five Crops

Highest ranked traits: Apple scion

Trait	Rank	Likelihood
Fruit crispness	5.00	96.40
Fruit juiciness	5.00	96.00
Consistent storage quality	5.00	88.00
Shelf-life	5.00	87.00
Acid/sugar balance	4.75	84.50
Flavor	4.75	79.25
Storage disorders	4.60	89.20
Fruit firmness	4.60	79.20
Fire blight	4.60	69.00
Sweetness	4.40	71.20

Highest ranked traits: Peach scion

Trait Name	Rank	Likelihood
Fruit firmness	4.88	92.25
Fruit uniformity	4.75	85.88
Fruit shape	4.71	83.29
Fruit size	4.63	88.75
Production consistency	4.63	87.50
Sweetness	4.63	76.38
Flavor	4.60	82.60
Productivity	4.57	89.57
Heat tolerance	4.57	70.57
Soluble solids(Brix)	4.50	83.25

Highest ranked traits: Strawberry

Trait Name	Rank	Likelihood
Flavor	4.89	94.56
Productivity	4.75	88.50
Shelf-life	4.67	83.89
Fruit size	4.60	88.70
Skin color	4.56	88.33
Extended harvest season	4.50	74.00
Production consistency	4.50	71.60
Fruit firmness	4.40	86.20
Shipping ability	4.33	81.78
Root rot	4.33	76.00

CONCLUSIONS

- It is difficult to develop thorough, sustained collaboration among breeding programs, even with financial and technical incentives
- Including social scientists adds difficulties
- Proper surveys are time-consuming, expensive, and essential
- Breeders consider most traits are important or very important
- Identification of target traits by economic weighting is difficult
- The experiment is underway, with great potential to achieve our intended impact

Thank you

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

Highest ranked traits: Sweet and Tart Cherry Scion

Sweet Cherry Scion			Tart Cherry Scion		
Trait Name	Rank	Likelihood	Trait Name	Rank	Likelihood
Fruit firmness	5.00	100.00	Fruit firmness	5.00	100.00
Fruit size	5.00	100.00	Fruit shape	5.00	100.00
Powdery mildew	5.00	96.00	Fruit uniformity	5.00	100.00
Extended harvest season	5.00	89.00	Pit shape and size	5.00	100.00
Self fertility	5.00	89.00	Pit splitting and fragments	5.00	100.00
Skin color	5.00	78.00	Machine harvest ability	5.00	100.00
Resistance to frost injury	5.00	73.00	Graft compatibility	5.00	100.00
Other disease-viral	5.00	44.00	Production consistency	5.00	100.00
Flavor	4.00	80.00	Skin color	5.00	56.00
Fruit juiciness	4.00	50.00	Flesh color	5.00	55.00