

# ROSBREED

Enabling marker-assisted breeding in Rosaceae

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

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S11 ISAFRUIT  
IHC LISBOA 26 Aug 2010



## Outline

RosBREED background

Preliminary results

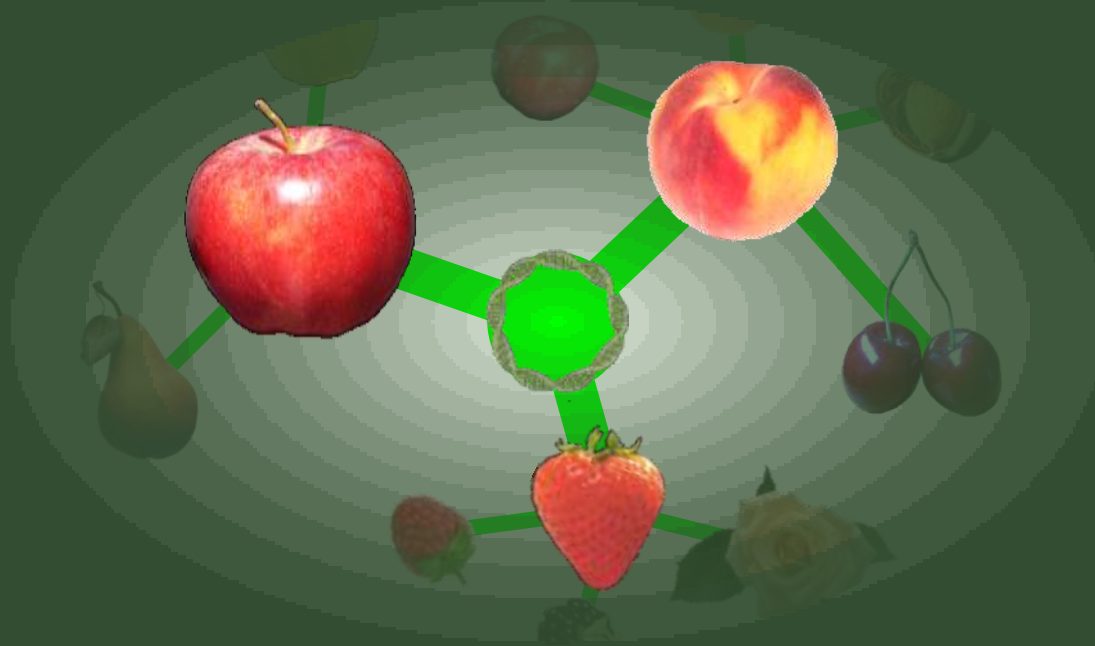
Breeder survey

Target traits

Marker assisted technology

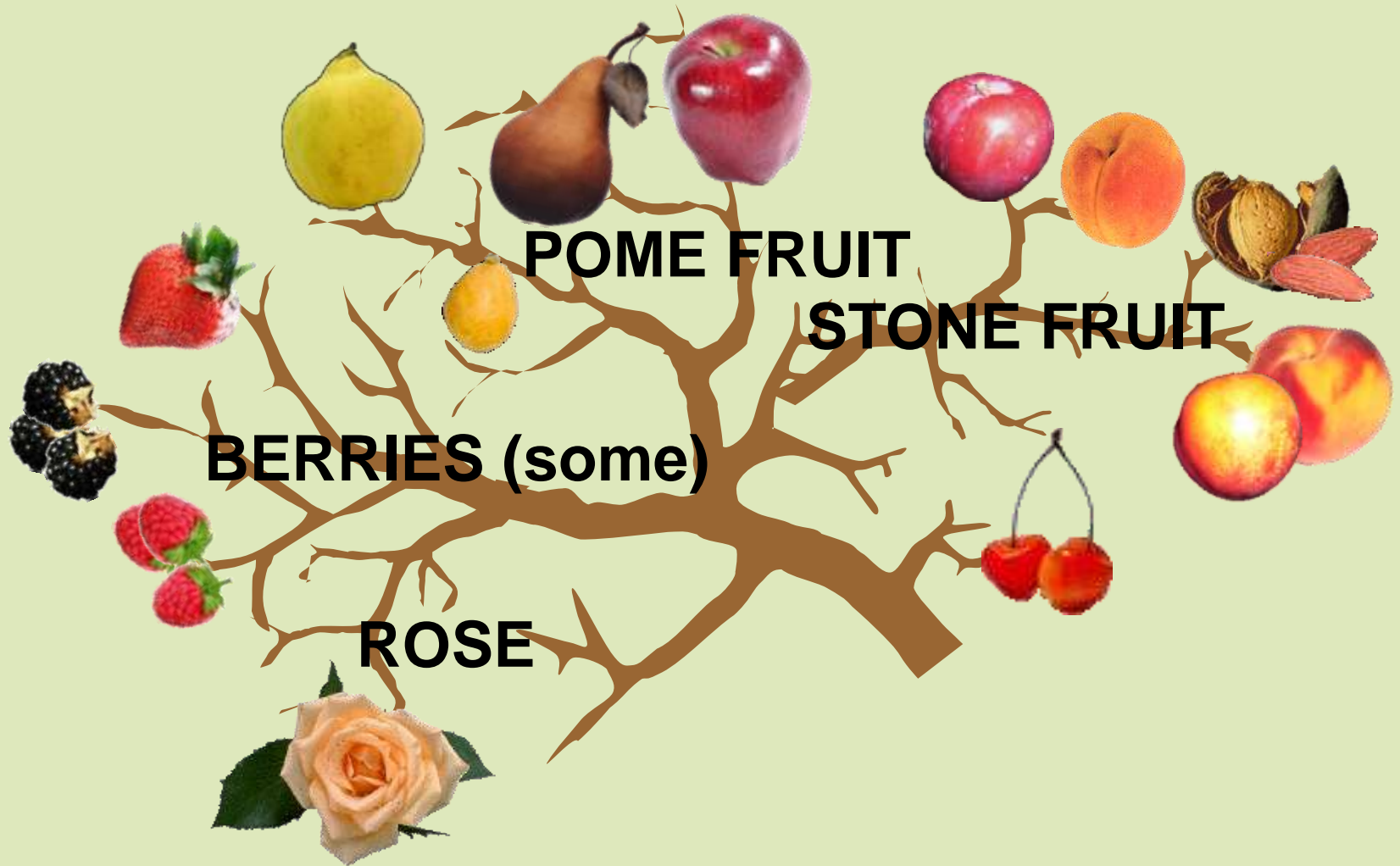
Relative importance of traits for five crops

Conclusions



RosBREED Background

# The Rosaceae family of horticultural crops.



**ROS**BREED

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[www.rosbreed.org](http://www.rosbreed.org)



## OUR DREAM

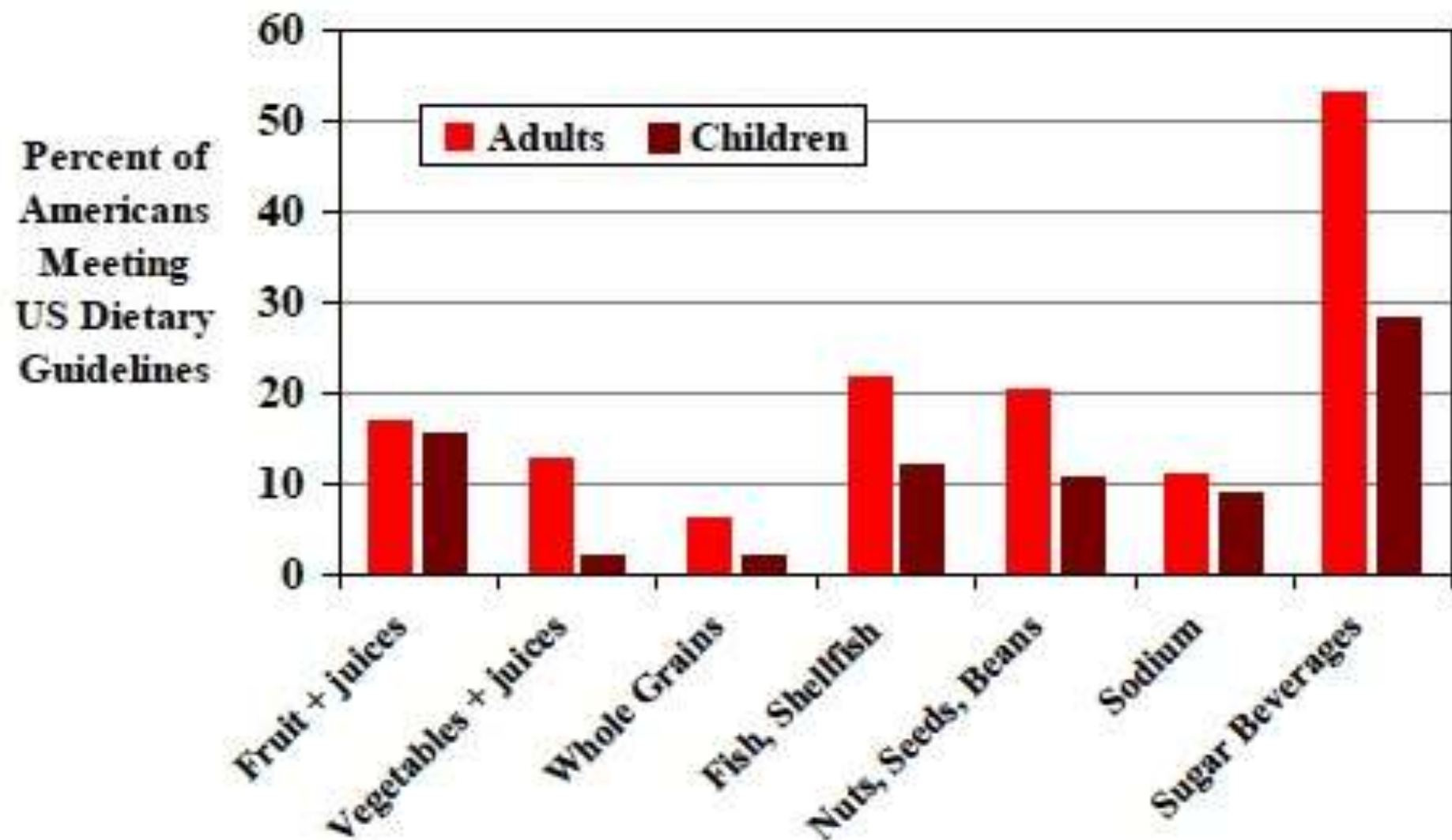
Ultra-crisp tasty apples  
sweet juicy peaches  
flavorful cherries  
luscious strawberries

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

A group of approximately 15 people, mostly men, are gathered in a field. They are dressed in casual work attire, including plaid shirts, polo shirts, and shorts. Some are wearing baseball caps. The background shows a large, semi-transparent white structure, possibly a greenhouse or a covered walkway, with trees visible behind it. A large white oval with a black border is superimposed on the upper part of the image, containing the word "Producers" in a bold, black, sans-serif font. A small white rectangular box with a blue border is located in the upper left corner of the image.

# 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



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

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# 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

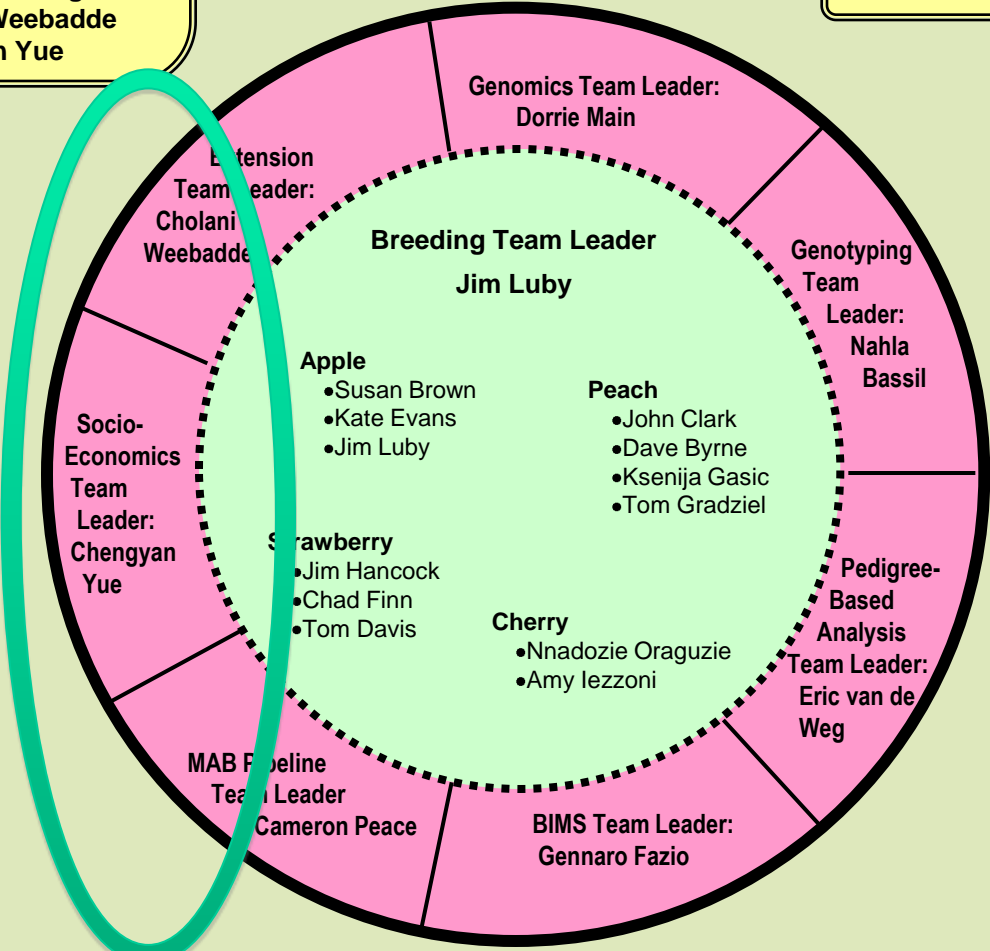
**Project Director**  
Amy Iezzoni

**Project Assistant**

**Co-PIs**  
29

**Organizations**  
11

**Intl partners**  
7



**Advisory panels**  
39

# RosBREED Participants



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



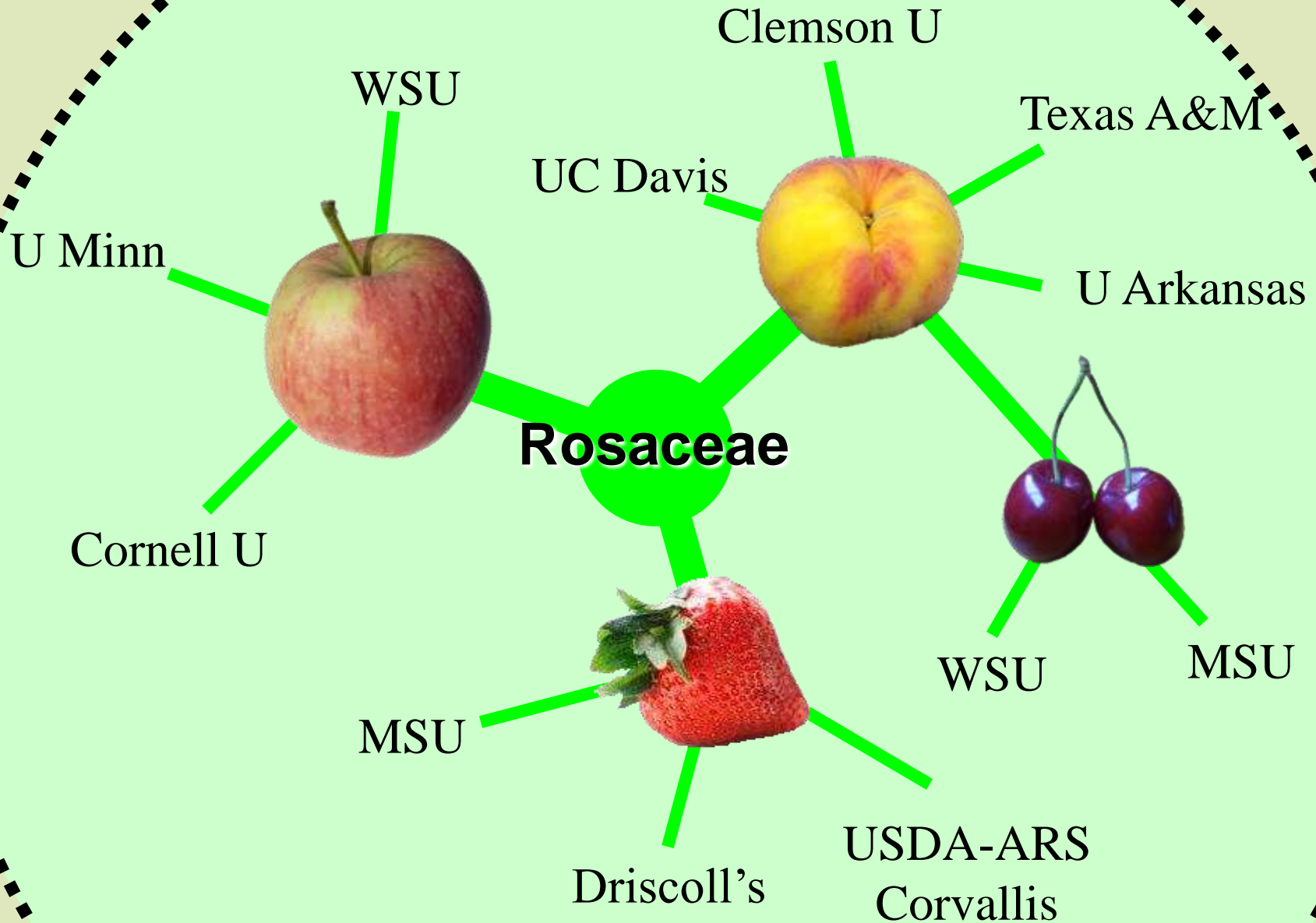
# RosBREED International Partners



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.



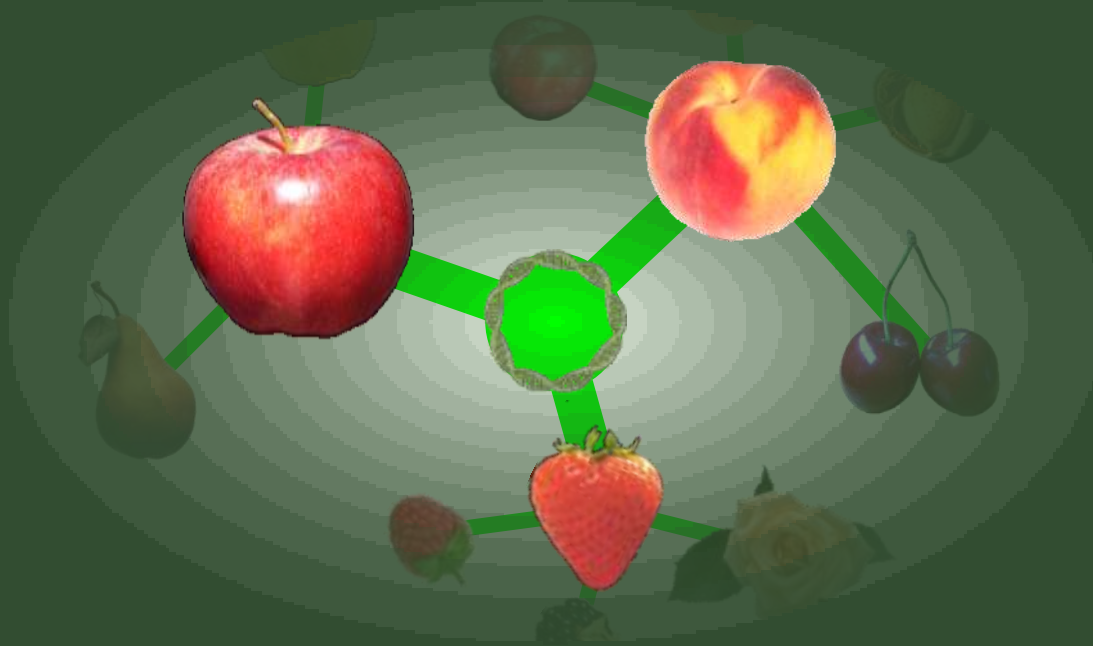
# Trait Impact: Focus on fruit quality

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**

qualtrics.com\*

1. What crop(s) are you currently breeding? Please check all that apply.

Strawberry

Apple Scion

Apple Rootstock

Pear Scion

Pear Rootstock

Tart Cherry Scion

Tart Cherry Rootstock

Sweet Cherry Scion

Sweet Cherry Rootstock

Peach Scion

Peach Rootstock

Plum Scion

Plum Rootstock

Apricot Scion

Apricot Rootstock

Almond Scion

Almond Rootstock

Blackberry

Red Raspberry

Black Raspberry

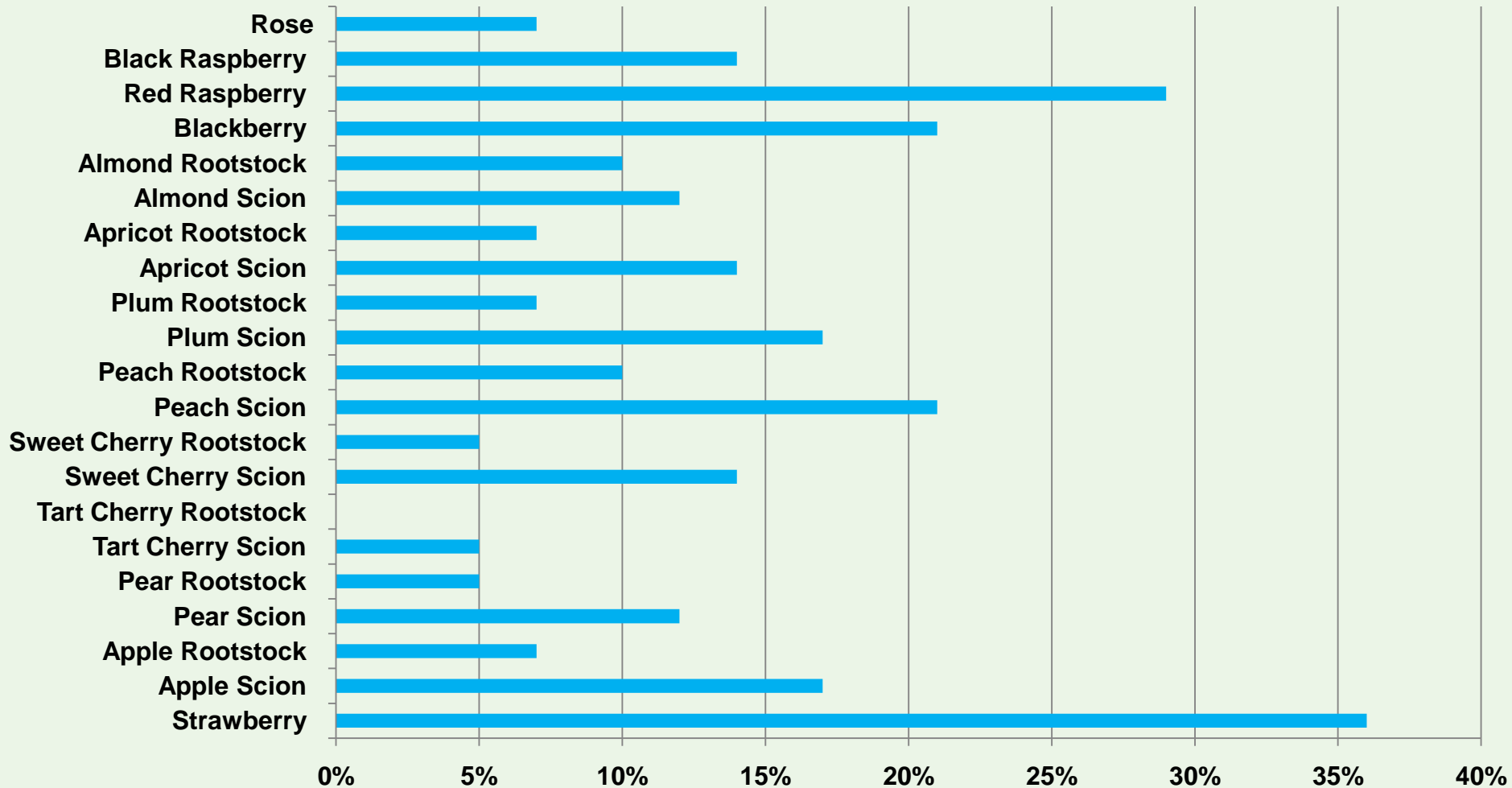
Rose

2. What are the target production region(s)? E.g., U.S. Pacific Northwest

>>



# Target crop(s)



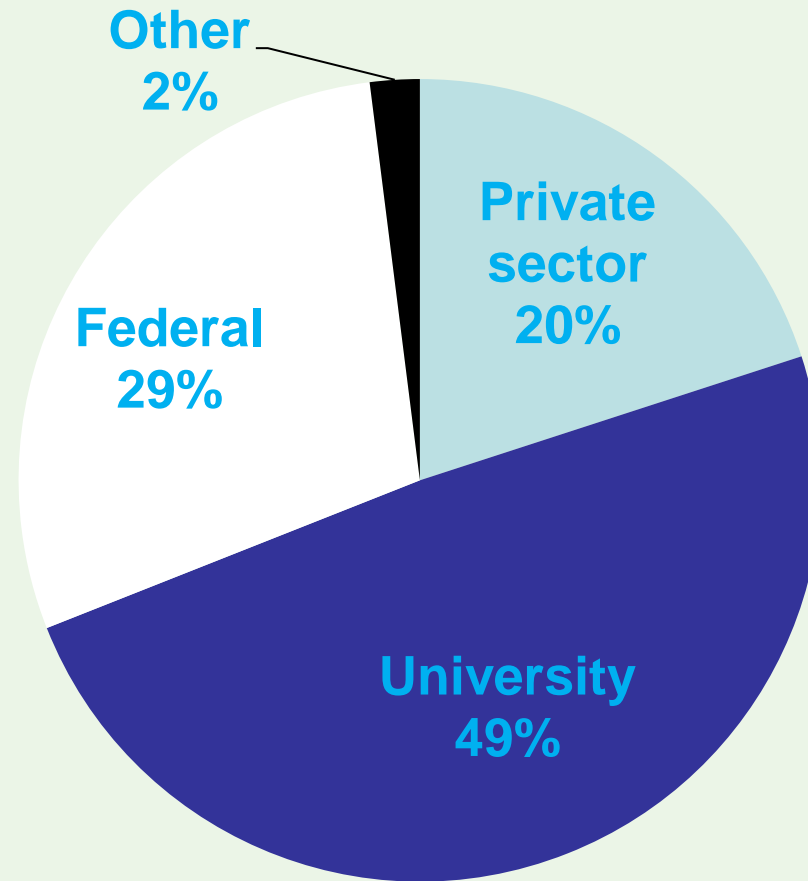
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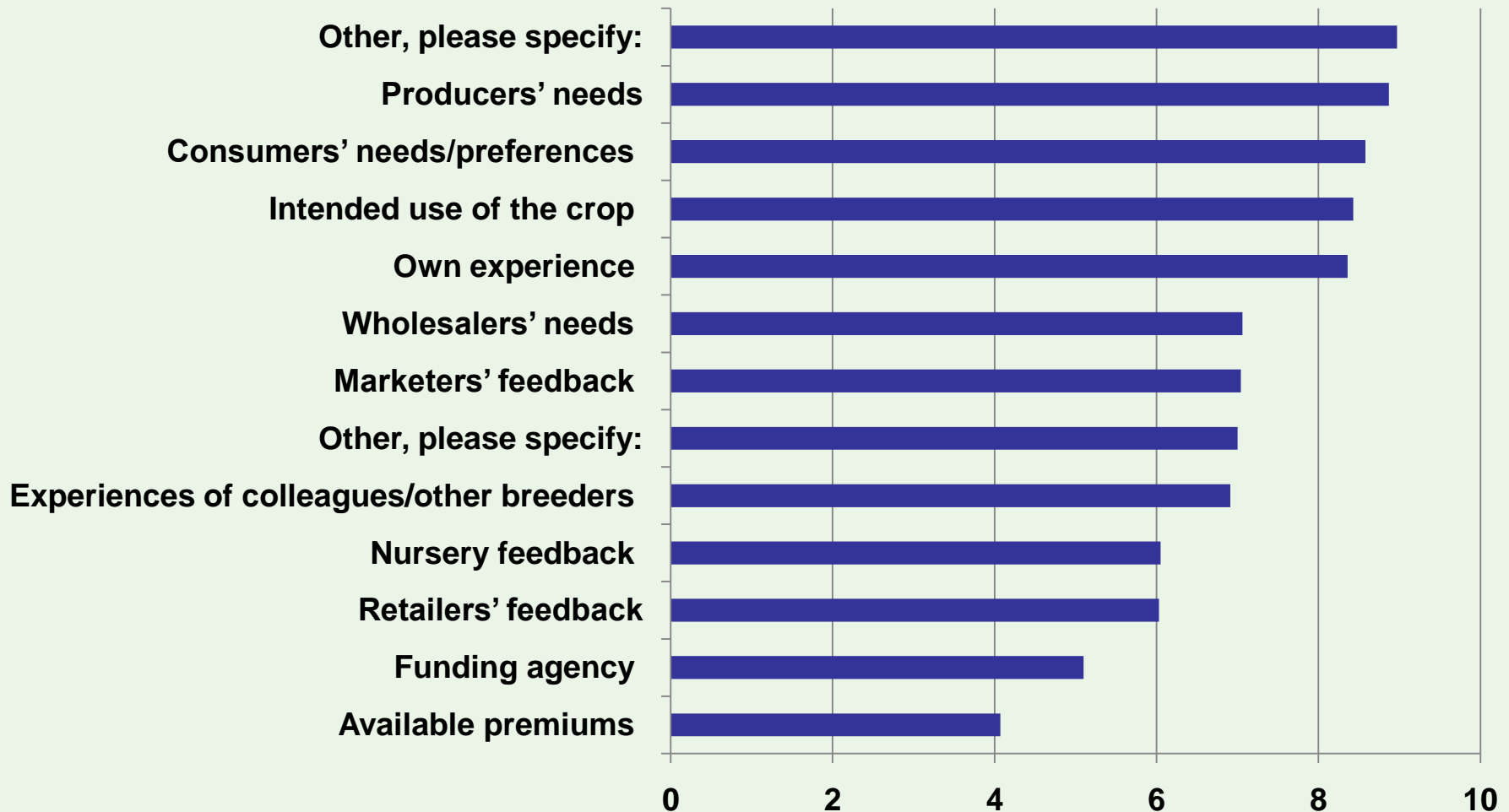


[www.rosbreed.org](http://www.rosbreed.org)

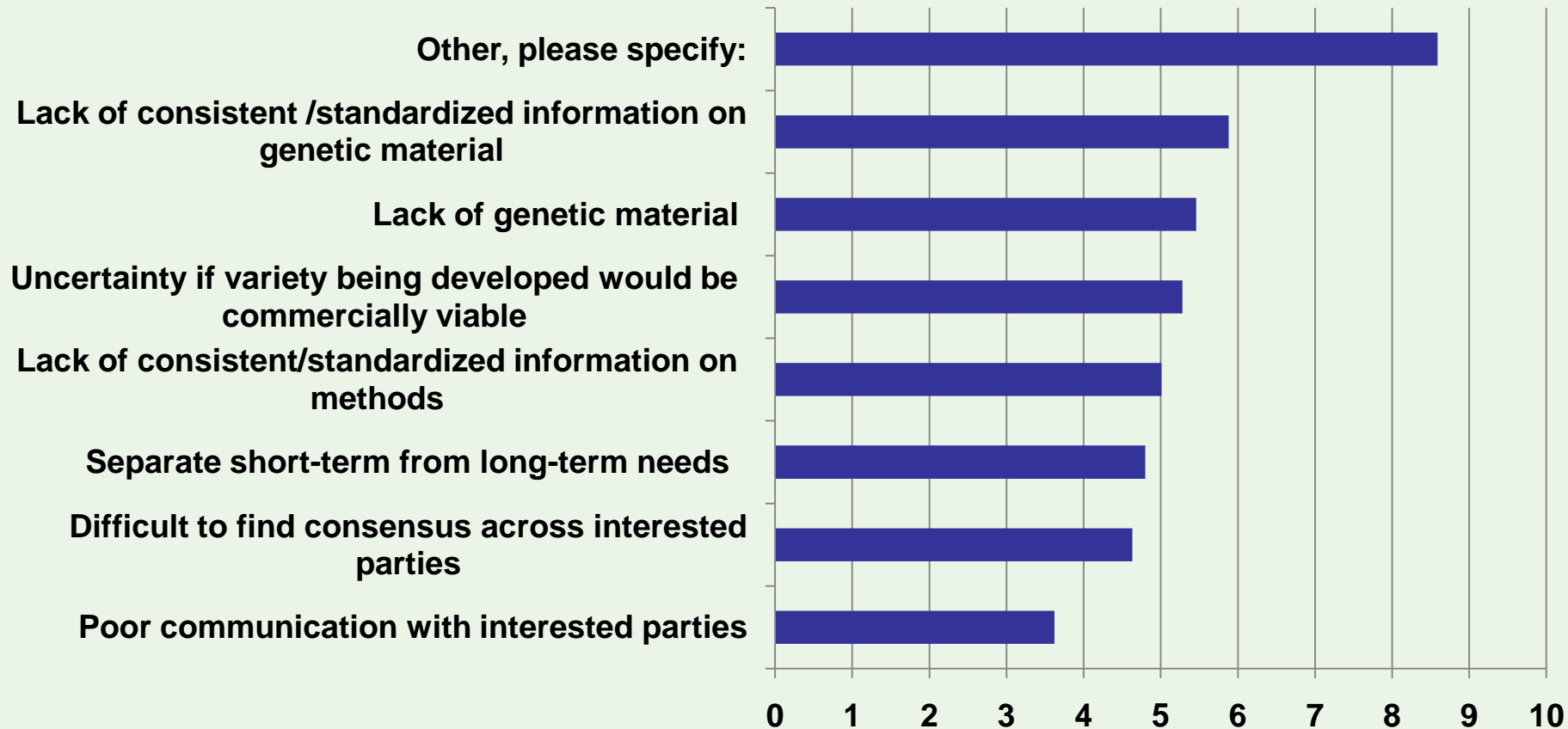
# What type of organization are you working at as a breeder?



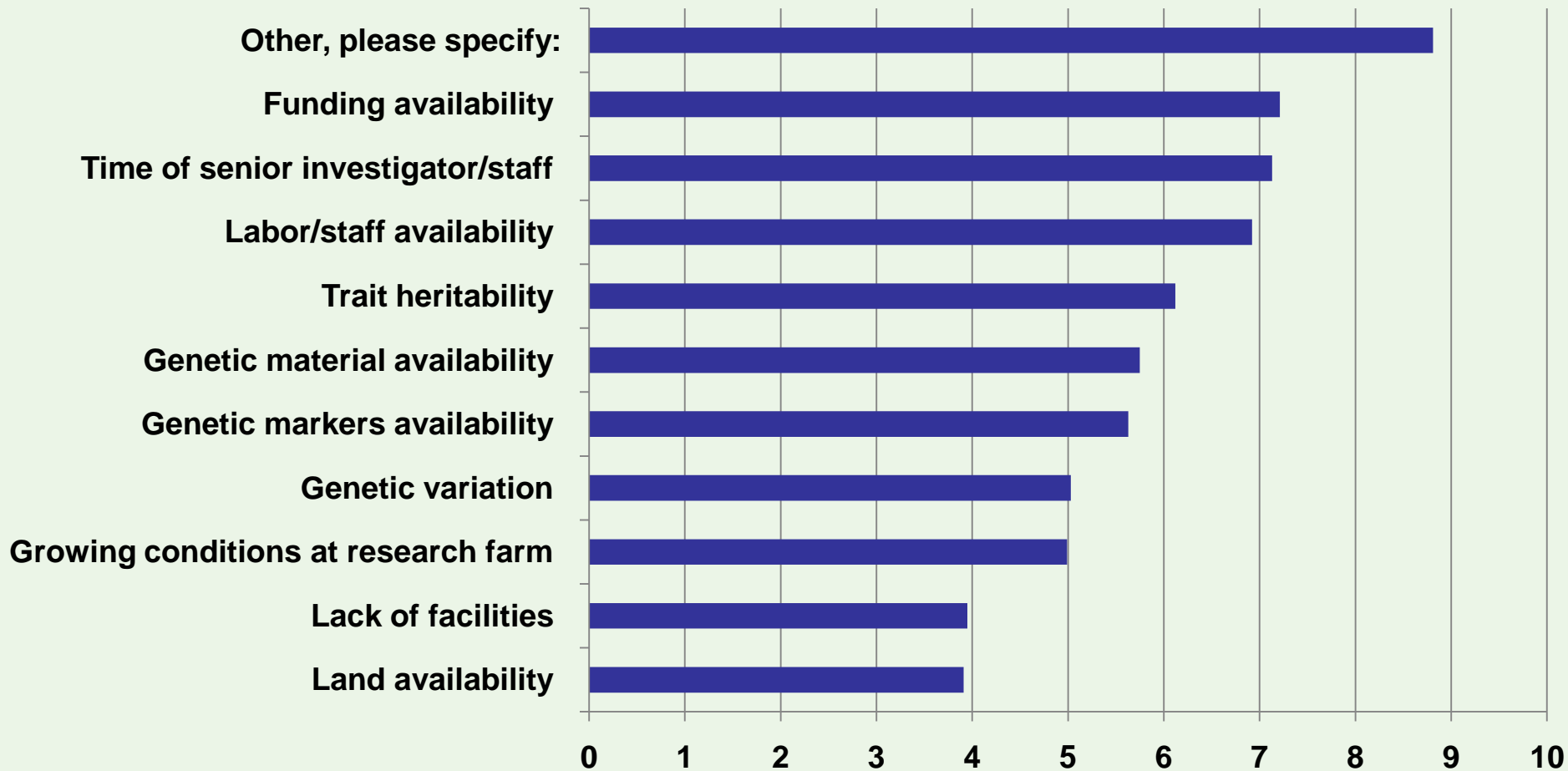
# Influence of interested parties (1-10 scale, mean value)

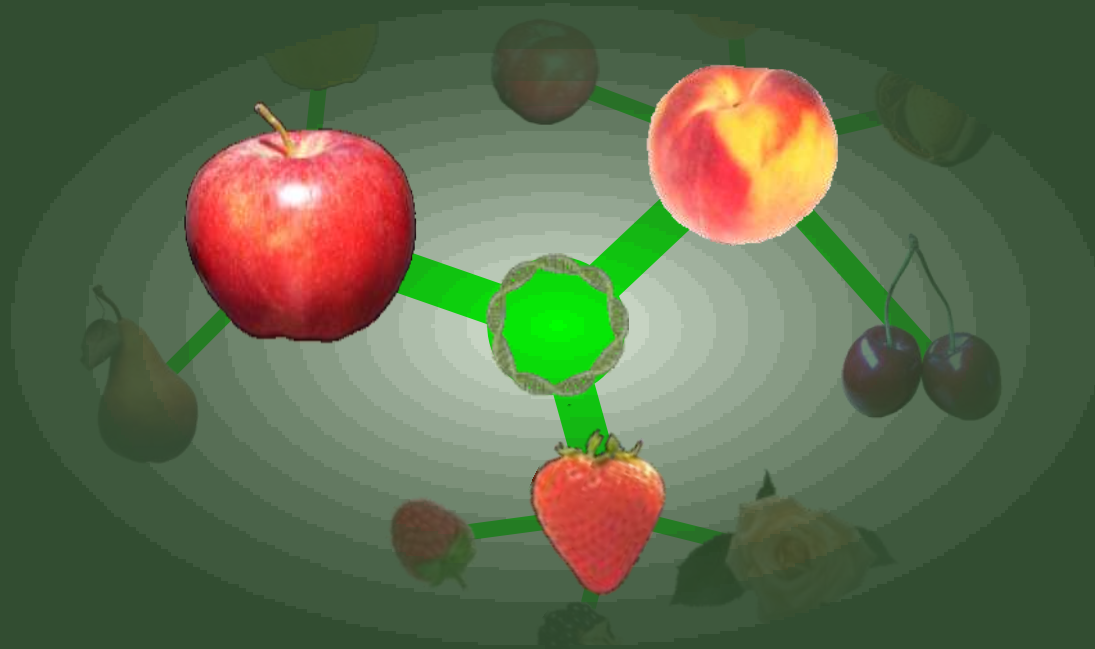


# Challenges in determining priorities (1-10 scale, mean value)



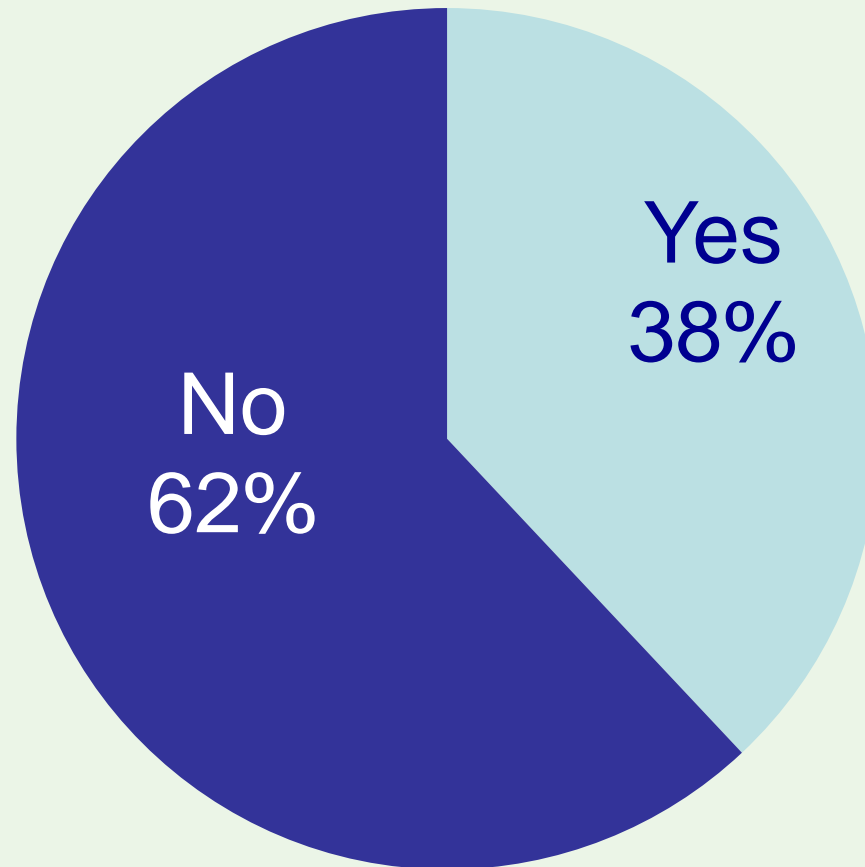
# Challenges in implementing priorities (1-10 scale, mean value)



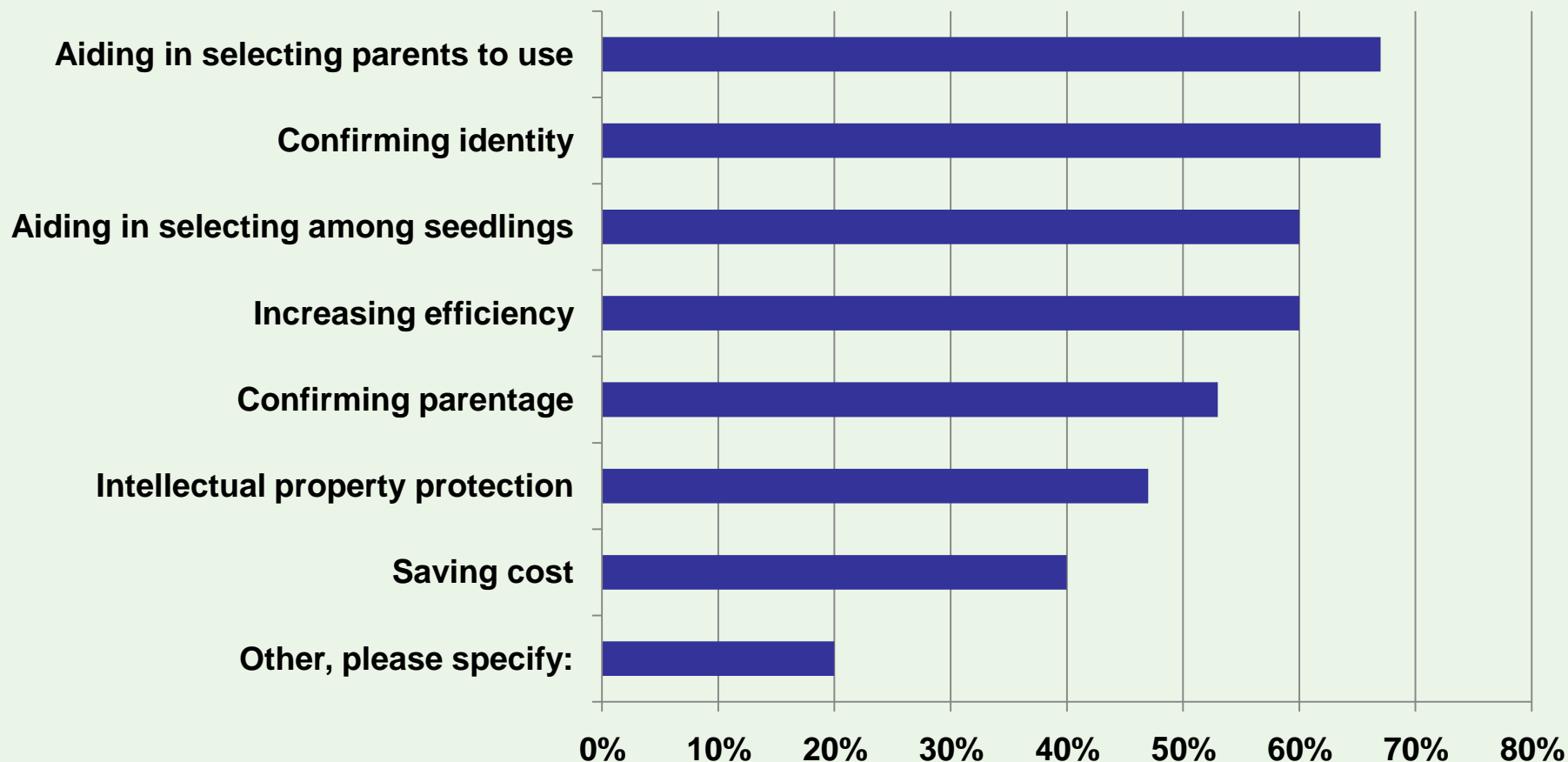


# Marker Assisted Technology

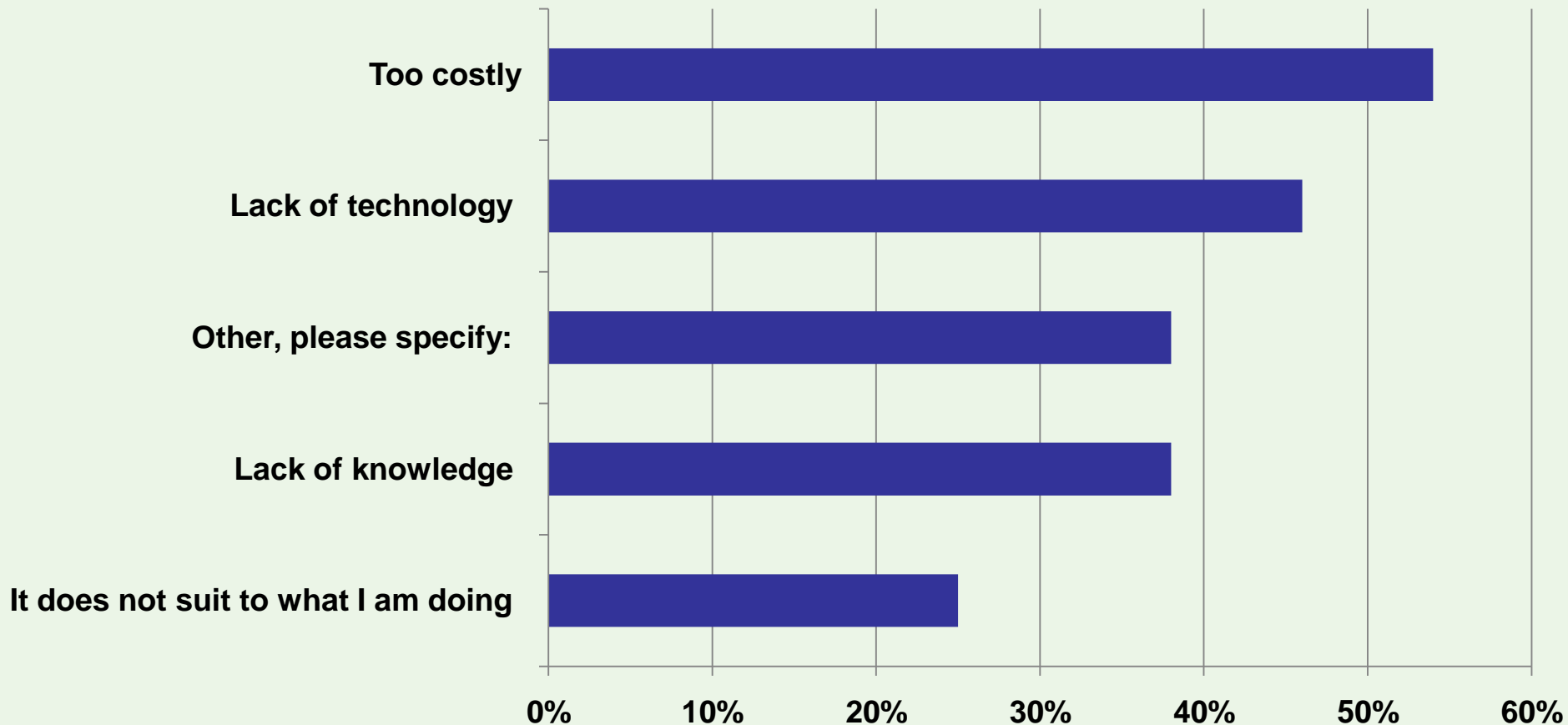
# Use marker assisted technology

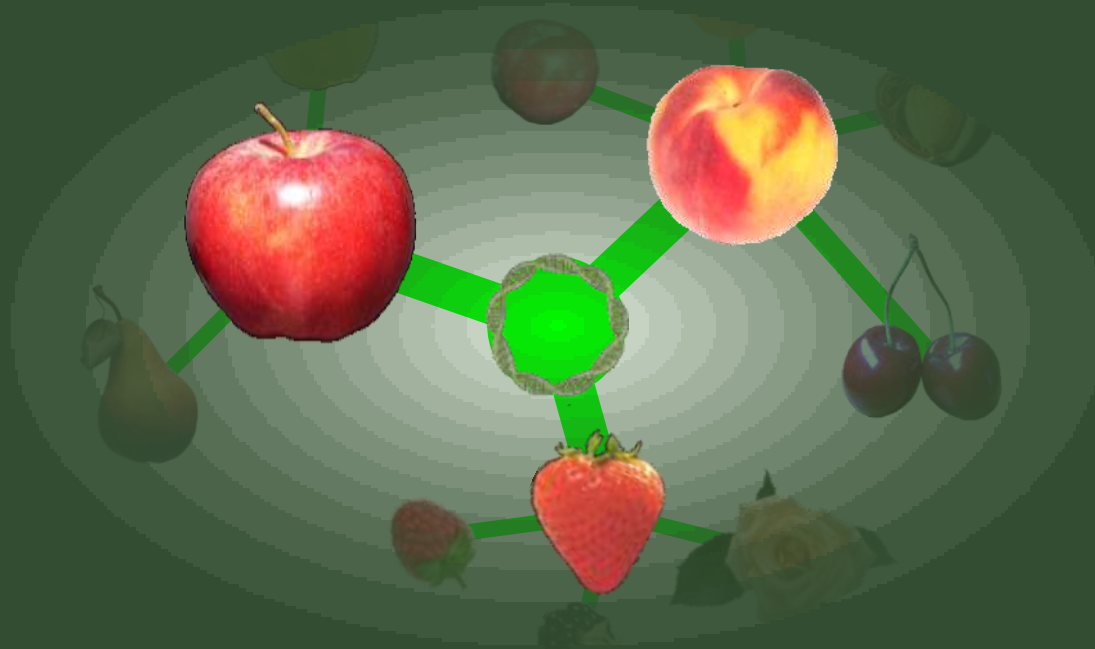


# Reason for using marker-assisted technology



# 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

