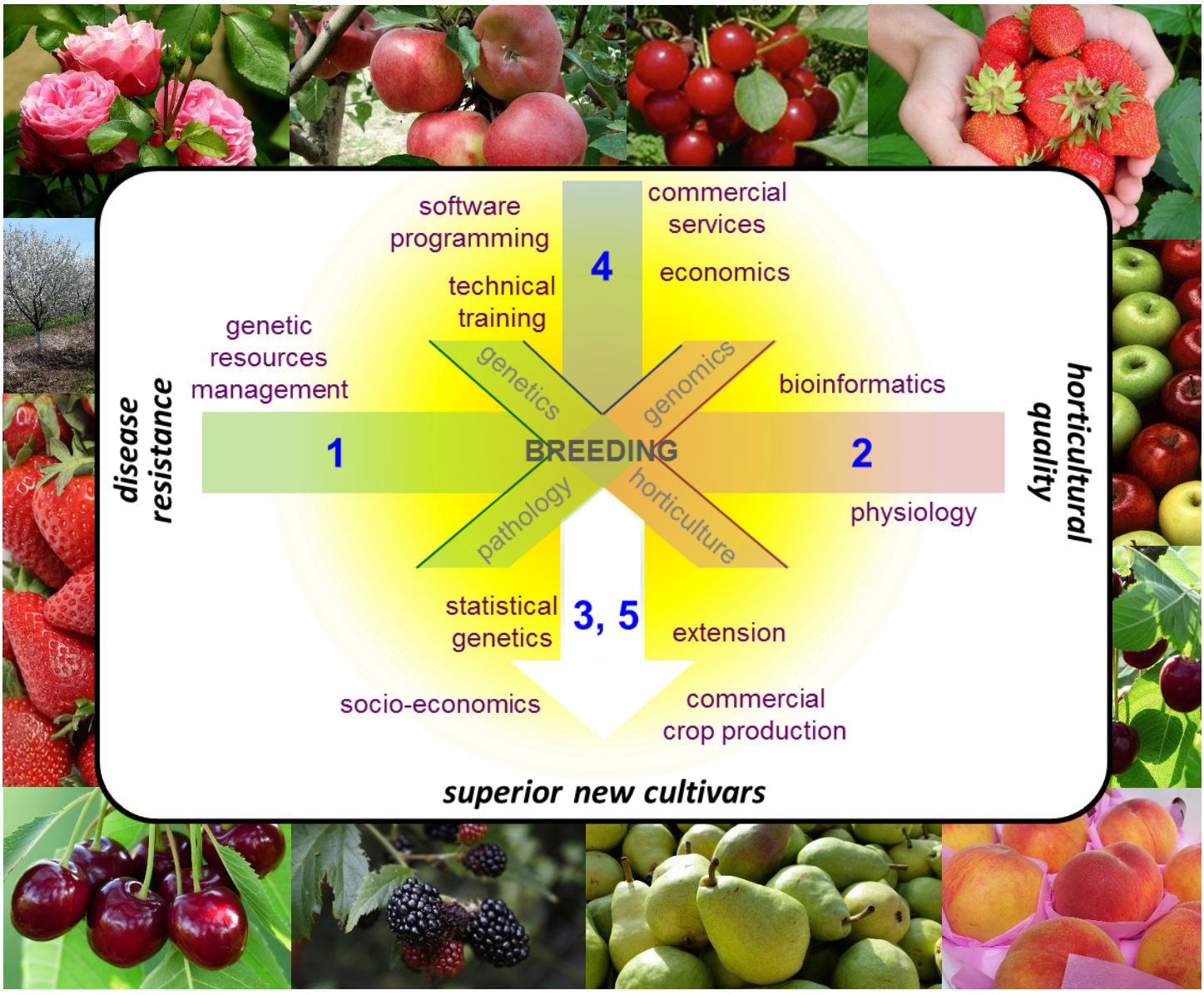
RosBREED Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars

# RosBREED
# Annual Project Report

*Dedicated to the genetic improvement of U.S. rosaceous crops*
www.rosbreed.org

USDA NIFA

**RosBREED Advisory Panel**
**Annual Meeting**
**January 8, 2015**
**San Diego, CA**



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RosBREED Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars

# Agenda

Thu, Jan 8, 2015
Shutters East/West Banquet Room
DoubleTree Hotel, 7450 Hazard Center Drive, San Diego, CA

| Start | End | Audience/ group | Presenter/ moderator | Title |
|---|---|---|---|---|
| 7:30 | 8:00 | Continental Breakfast | | |
| 8:00 | 8:30 | All | Amy Iezzoni | Introductions and Agenda |
| 8:30 | 9:20 | All | Amy Iezzoni | The Making of RosBREED 2 |
| 9:20 | 9:40 | All | Team Leaders | Obj. 1: Incorporate durable disease resistance into breeding parents |
| 9:40 | 10:00 | All | Team Leaders | Obj. 2: Combine disease resistance and horticultural quality |
| 10:00 | 10:30 | Break | | |
| 10:30 | 10:50 | All | Team Leaders | Obj. 3: Advance selections with improved confidence |
| 10:50 | 11:15 | All | Team Leaders | Obj. 4: Increase routine use of DNA information in rosaceous crop breeding |
| 11:15 | 11:35 | All | Team Leaders | Obj. 5: Utilize stakeholder input |
| 11:35 | 11:45 | All | Amy Iezzoni | Charge to afternoon break-out groups |
| 11:45 | 1:15 | Lunch | | |
| 1:15 | 1:30 | All | Cameron Peace | Additional discussion questions |
| 1:30 | 3:00 | Discussion session | Group 1 | Industry |
| | | | Group 2 | Extension |
| | | | Group 3 | Scientific |
| 3:00 | 3:30 | Break | | |
| 3:30 | 4:15 | All | Groups moderators | Reports & Discussion – possible next steps |
| 4:15 | 5:00 | All | Cameron Peace | Round table |
| 5:00 | Dinner on your own or in working groups | | | |

# RosBREED

**Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars**

## What is RosBREED?

RosBREED is a multi-state, multi-institution project dedicated to the genetic improvement of U.S. rosaceous crops by targeted applications of genomics knowledge and tools to accelerate and increase the efficiency of breeding programs.

This Coordinated Agricultural Project is funded through the Specialty Crop Research Initiative by a combination of federal and matching funds, grant 2014-51181-22378.

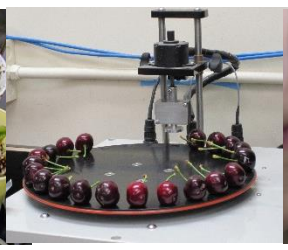
## What stakeholder and consumer needs does RosBREED address?

The perfect cultivar of apple, cherry, peach, strawberry, rose, and other rosaceous crops, one which consistently exceeds consumer expectations with satisfying appearance, aroma, flavor, shelf life, and texture AND also meets industry needs for durable disease resistances and productivity, remain elusive.

Yet, such rosaceous cultivars are possible. The components exist – but they must be combined.

## What is our vision?

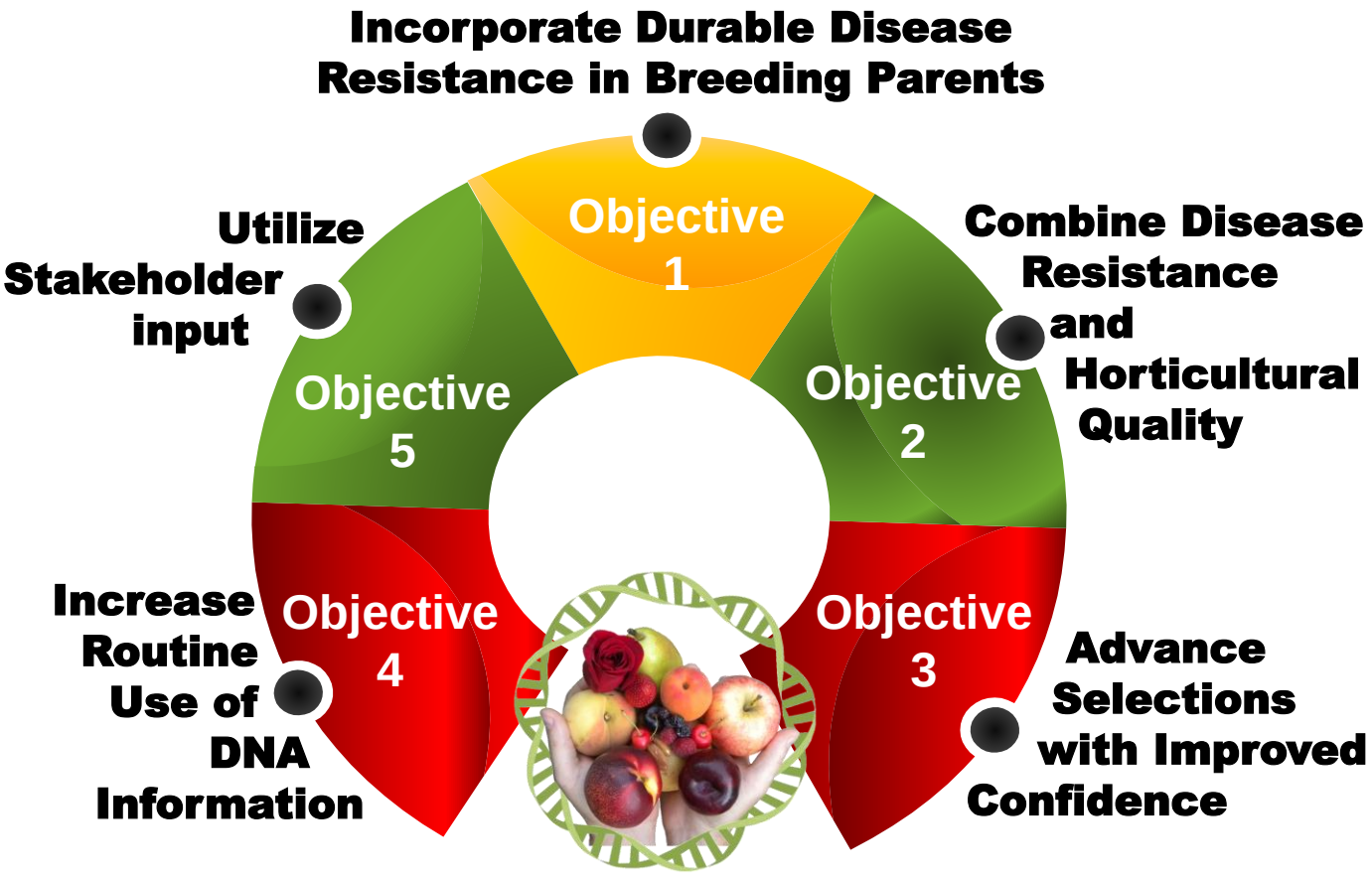
Combining horticultural quality, durable disease resistance, and productivity into new cultivars can be achieved through the coordinated application and implementation of new scientific advances.


## What does success look like?

- Consumers are satisfied, repeat customers
- Rosaceous crop industries are more profitable and sustainable
- Plant breeding programs are more efficient and effective

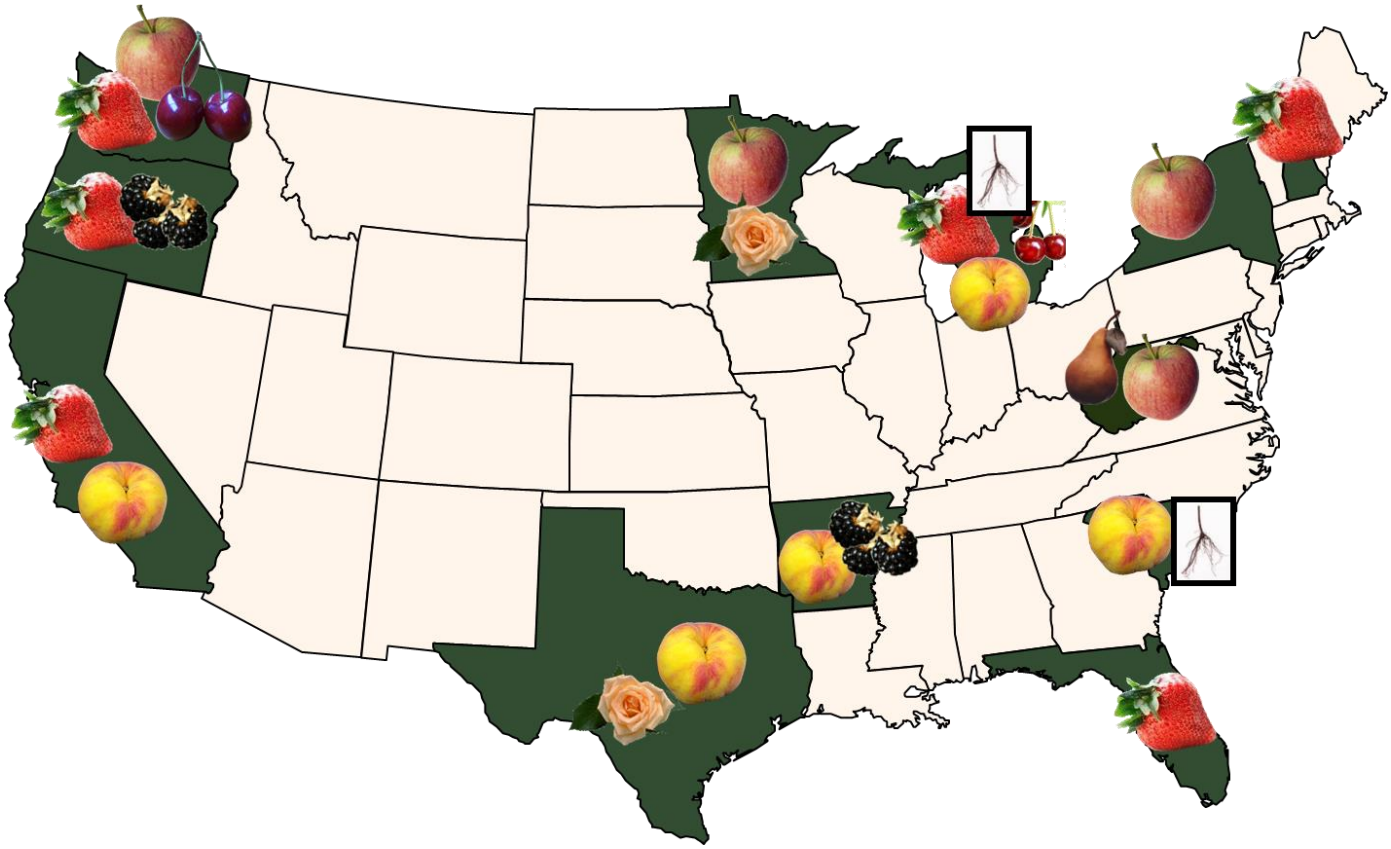
## RosBREED Goals



# RosBREED

**Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars**

## Targeted Crops, Breeders, & Diseases



**Apple:** Scab, Blue mold, Fire blight
- Washington State Univ. (Kate Evans)
- Univ. of Minnesota (James Luby)
- Cornell Univ. (Susan Brown)
- USDA-ARS Kearneysville (Jay Norelli)

**Peach (scion & rootstock)**: Bacterial spot, Brown rot, *Armillaria* root rot
- Clemson Univ. (Ksenija Gasic)
- Univ. of Arkansas (John Clark)
- Texas A&M (David Byrne)
- Univ. of California Davis (Tom Gradziel)
- Michigan State Univ. (William Shane)

**Pear**: Fire blight
- USDA-ARS Kearneysville (Richard Bell)

**Sweet cherry**: Powdery mildew
- Washington State Univ. (Nnadozie Oraguzie)

**Tart cherry (scion & rootstock)**: Cherry leaf spot, *Armillaria* root rot
- Michigan State Univ. (Amy Iezzoni)

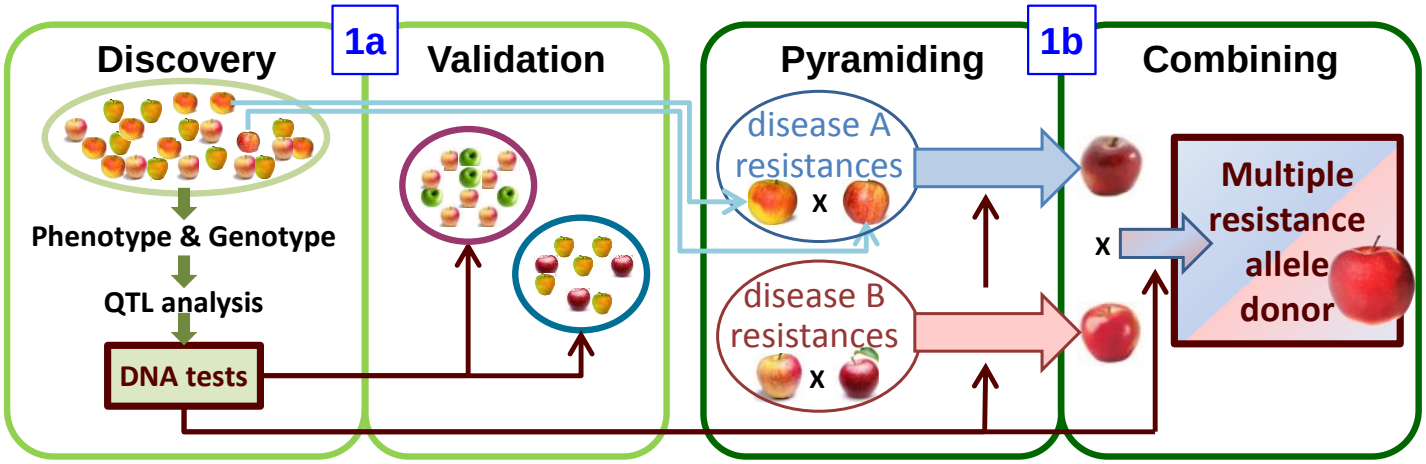
**Rose**: Black spot
- Univ. of Minnesota (Stan Hokanson)
- Texas A&M Univ. (Dave Byrne)

**Strawberry**: Root and Crown rots, Bacterial angular leaf spot
- Michigan State Univ. (James Hancock)
- USDA-ARS Corvallis (Chad Finn)
- Univ. of Florida (Vance Whitaker)
- Univ. of New Hampshire (Tom Davis)
- Washington State Univ. (Pat Moore)

**Blackberry** - Fruit sweetness. This is the overwhelming need as there is not a major disease threat
- Univ. of Arkansas (John Clark)
- USDA-ARS Corvallis (Chad Finn)

## OBJECTIVE 1
## Incorporate Durable Disease Resistance in Breeding Parents

U.S. Rosaceae breeders, collaborating with pathologists, will identify and incorporate disease resistance alleles into breeding parents. Use of these parents will enable new disease resistant cultivars to be developed more rapidly, as these parents will donate multiple resistance alleles to their progeny.




**Methods Overview:** Participating teams of U.S. Rosaceae breeders and pathologists will:

**1a** identify and validate alleles for disease resistance by QTL analysis, and

**1b** incorporate these by marker-assisted introgression into breeding parents, termed here "multiple resistance allele donors". These multiple resistance allele donors, with pyramided resistance alleles from multiple sources for one disease and/or combined resistance alleles for multiple diseases, will be made available to breeders U.S.-wide.

**Timeline**: **1a** will be initiated in Year 1 and completed at the end of Year 3. **1b** will start in Year 1 for apple and begin for all other crops in Year 4, with resistance alleles pyramided or combined from at least two sources accomplished by Year 5.

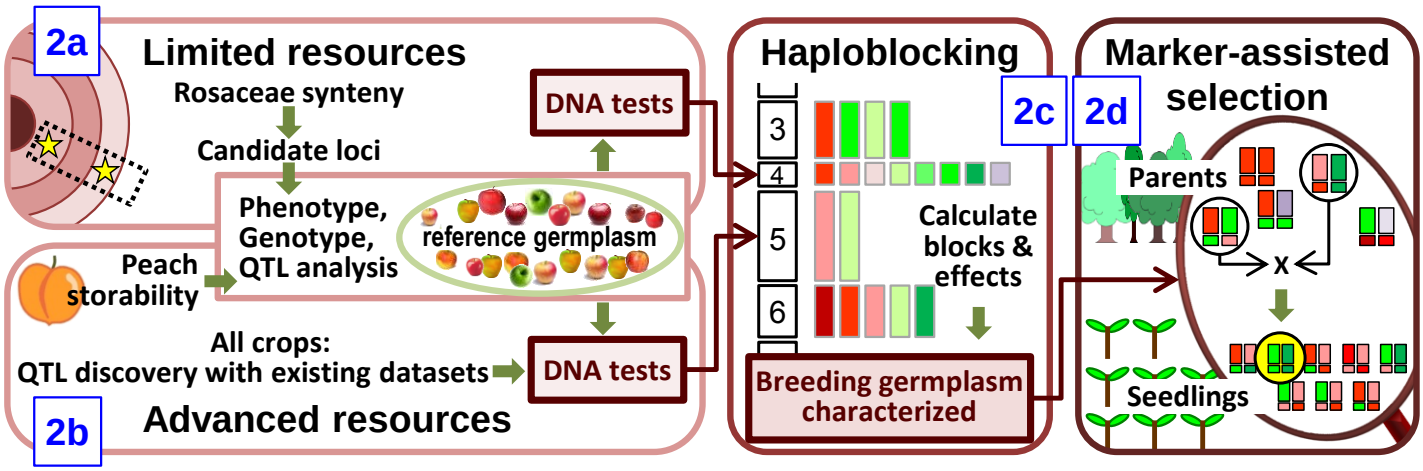
Jay Norelli

Guido Schnabel

Kelly Ivors

## OBJECTIVE 2
## Combine Disease Resistance and Horticultural Quality

Development of cultivars that combine excellent horticultural quality and disease resistance will be enabled with knowledge of desirable alleles and their locations in the genome.




**Methods Overview**: New large-effect fruit quality alleles will be discovered by:

**2a** leveraging syntenic genomic locations of QTLs, and

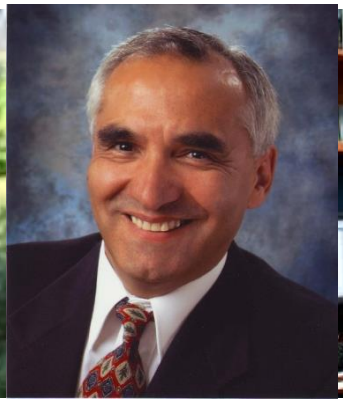
**2b** using a genome-wide pedigree-based analytical approach.

**2c** Alleles within regions contributing to desired phenotypes will be identified by haplotype blocking to expand selection decisions from individual loci and traits to many linked loci and traits.

**2d** Marker-assisted parent and seedling selection will combine disease resistance with superior horticultural quality in the next generation of breeding families.

**Timeline**: **2a–2c** will be initiated in Year 1, completed Year 3. **2d** will be Year 1-5 (apple, peach, strawberry, cherry) or Year 4-5 (rose, blackberry, pear).


Dorrie Main

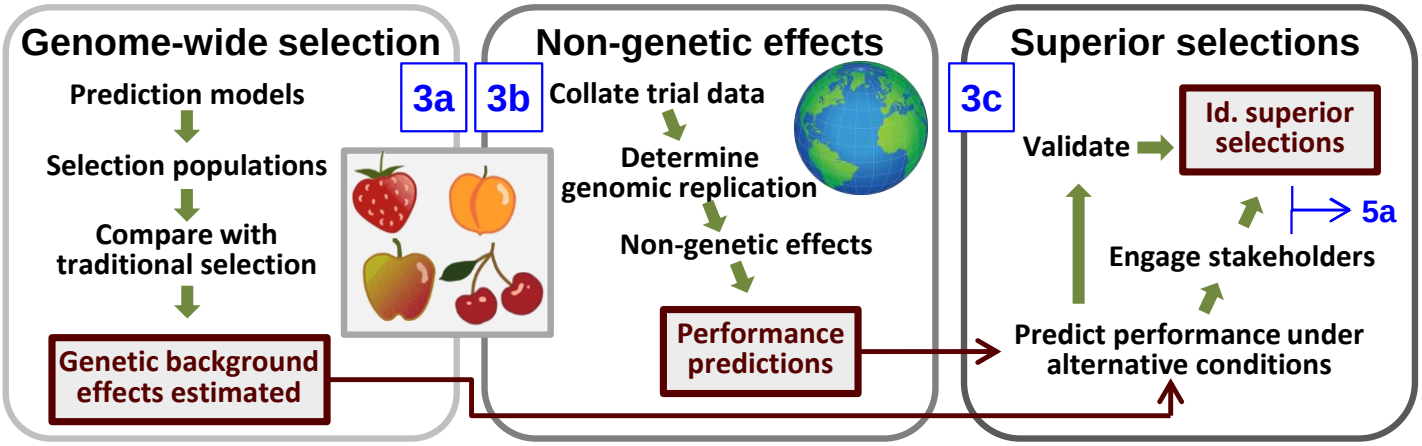

Carlos Crisosto


Amy Lawton-Rauh


Stephen Kresovich

## OBJECTIVE 3
## Advance Selections with Improved Confidence

New selections will be advanced toward commercial release with improved confidence due to more accurate predictions of fruit quality performance which includes estimates of non-genetic factors (e.g., cultural practices, climate) and alleles at small-effect loci across the entire genome.




**Methods Overview**: Influences of genetic background and non-genetic factors will be identified using new statistical approaches to improve accuracy of predictions of genetic potential based on large-effect horticultural quality and disease resistance QTLs in apple, peach, sweet cherry, and strawberry breeding germplasm.

**3a** Genome-wide prediction models will calculate relative effects of genetic background (cumulative effects of individually small-effect alleles) using existing high-resolution phenotypic and genotypic datasets.

**3b** Genomic relationship matrices using dense SNP arrays will be used to merge RosBREED datasets with trials in the U.S. and other countries. Effects of non-genetic factors (e.g., management, climate, G × E) will be evaluated to improve prediction accuracy of genetic potential among and within these factors.

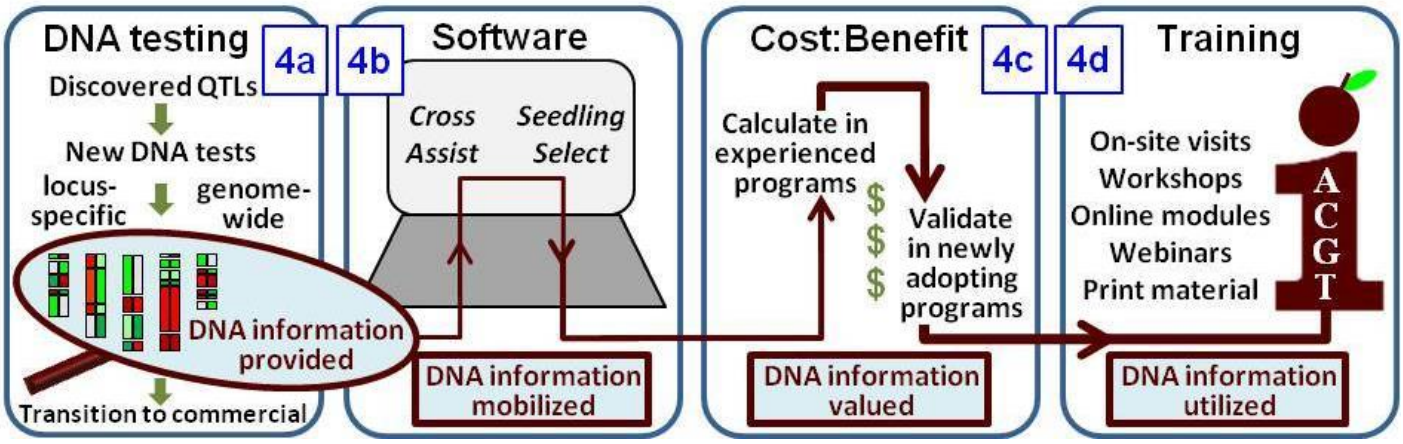
**3c** In case studies, performance stability of elite selections under alternative growing conditions will be predicted using **3a** and **3b** results, validated, and used to streamline selection advancement and engage stakeholders in the latter stages of their breeding programs.

**Timeline**: **3a** and **3b** will be initiated in Year 1 with data compilation and analysis completed in Year 4. **3c** will be conducted in Year 4.

Vance Whitaker  Rex Bernardo  Craig Hardner

## OBJECTIVE 4
## Increase Routine Use of DNA Information

The development of cost-effective and accessible DNA diagnostic tools will enable DNA-informed breeding to be widely adopted by rosaceous crop breeders leading to increased breeding efficiency.




**Methods Overview**:

**4a** Cutting-edge DNA diagnostic tools will be developed and crop-specific DNA testing services will be made available.

**4b** DNA Information will be integrated into enhanced decision-support software.

**4c** Cost-benefit analyses will be conducted that identify tangible dollar values for DNA-informed breeding applications.

**4d** Breeders and allied scientists will receive technical training in use of DNA information in breeding.

Nahla Bassil

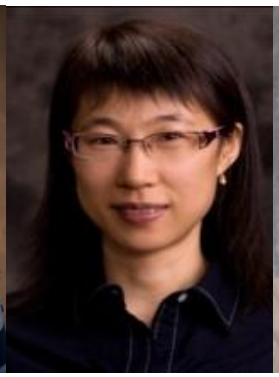
**Timeline**: **4a** will be initiated in Year 1 and tool development will continue until the end of Year 5. **4b** software enhancement will be completed in Year 1 and information integration will start in Year 1 and end in Year 5. **4c** cost:benefit analyses will begin in Year 1 and new adoption case studies will begin in Year 2; all will be completed in Year 4. **4d** technical training will be ongoing for all five years.

CUGI Clemson University Genomics Institute

Chris Saski

Cameron Peace

Mercy Olmstead



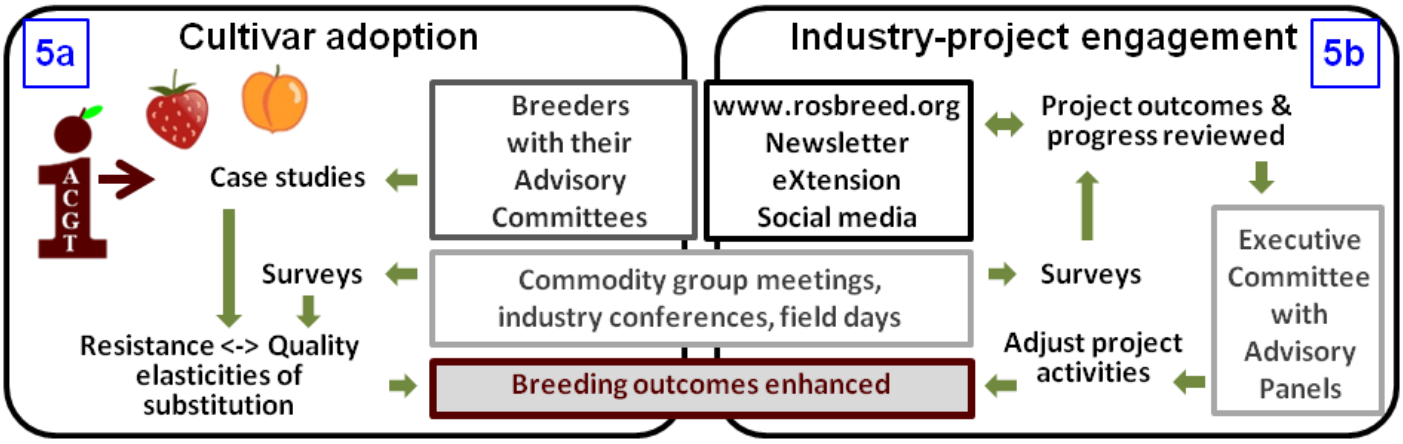
Chengyan Yue

Vicki McCracken

Karina Gallardo

## OBJECTIVE 5
## Utilize Stakeholder Input

The impact of new cultivars will be maximized with stakeholder input into cultivar trait priorities and improved predictability of commercial performance of new cultivars. Due to the geographic and crop diversity within RosBREED, stakeholder input and recommendations will be specific for individual crop breeding programs.



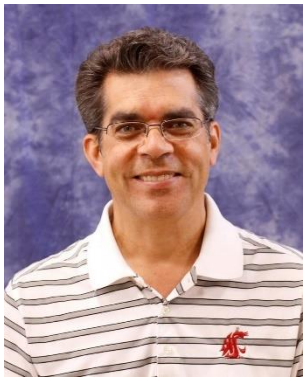

**Methods Overview**:

**5a** Stakeholder decisions on new cultivar adoption will be systematically investigated in two breeding programs.

**5b** Stakeholders will be engaged in project outcomes, evaluation, and adjustments.

**Timeline**: **5a** will be initiated in Year 2, with surveys conducted in Years 3 and 4. **5b** stakeholder activities will follow an annual timeline for all five years supplemented with extension activities.


Mercy Olmstead


Des Layne

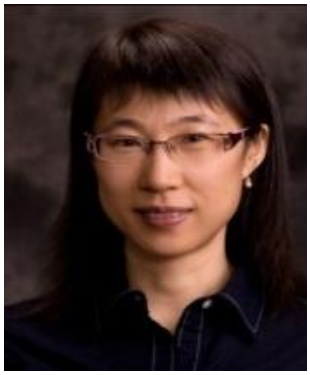

Vance Whitaker


Lisa Wasko DeVetter


Greg Reighard


Vicki McCracken


Karina Gallardo


Chengyan Yue

# Table 1: Objective 1 Planned Deliverables for Year 1 (green) and Challenges (blue)

| Objective | Sub-Objective | What | To Whom | Impact |
|---|---|---|---|---|
| **1 Incorporate Durable Disease Resistance in Breeding Parents** | **1a.** Disease resistance allele discovery and validation | Standardized disease phenotyping protocols including the most appropriate pathogen strain(s) – established | Crop Breeding Teams and Pathology Team | These plant materials and their phenotypic and genotypic data will lead to discovery of loci associated with disease resistance and enable development of DNA tests for breeding application |
| | | Strawberry root and crown rot plant materials established at Cal Poly; disease phenotyping – initiated | Strawberry pathologists and strawberry breeders | |
| | | Disease phenotypic data of plant materials for 2015 season – completed | Crop Breeding Teams and Pathology Team | |
| | | Genotypic data of those populations phenotyped for disease resistance – obtained | Crop Breeding Teams and DNA Testing Team | |
| | **1b**. Pyramid and combine disease resistance alleles | Progeny from crosses created to pyramid disease resistance alleles – obtained | Crop Breeding Teams | These progenies will provide individuals that breeders can use as parents to develop cultivars with more durable disease resistance due to the presence of resistance from multiple loci |

| Objective | Challenge | Plan for Tackling |
|---|---|---|
| **1 Incorporate Durable Disease Resistance in Breeding Parents** | Crown and root rot resistance is not identified in the strawberry germplasm chosen for screening | Screen germplasm of different ancestry than that previously examined |
| | Inconsistent disease phenotypic data obtained across locations and time despite standardized phenotyping protocols | Develop laboratory/greenhouse screening protocols such as detached leaf assays (bacterial spot on leaves - peach; black spot - rose), *ex situ* laboratory fruit inoculations (brown rot - peach), or initial seedling evaluations in the greenhouse (fire blight - apple) |
| | Some genetic resistances may be due to many small-effect alleles across multiple loci and therefore difficult to individually detect and introgress | Search for other sources of resistance or use other DNA-informed breeding approaches such as genome-wide selection (Obj. 3a) |

# Table 2: Objective 2 Planned Deliverables for Year 1 (green) and Challenges (blue)

| Objective | Sub-Objective | What | To Whom | Impact |
|---|---|---|---|---|
| **2 Combine Disease Resistance and Horticultural Quality** | **2a.** Horticultural quality allele discovery and validation – RosMAP | RosMAP online tool – completed and introduced to user community | Crop Breeding and DNA Testing Teams | This resource will provide a shortcut to locate candidate trait loci with common ancestral origin across rosaceous genera. The case study for this strategy will seek to identify loci controlling soluble solids content in blackberry and pear |
| | | Germplasm sets of blackberry and pear – genotyped and pedigrees confirmed | Blackberry and pear breeding teams | |
| | **2b.** Horticultural quality allele discovery and validation – advanced resources | Standardized peach postharvest fruit quality phenotyping protocol – developed | Peach breeders | Rosaceae breeders will have many new available DNA tests for valuable traits. Peach breeders will benefit from DNA tests for post-harvest traits. Strawberry breeders will have knowledge of which strawberry accessions to advance based on knowledge of both horticultural traits and root and crown rot resistance |
| | | Advanced Peach Crop Reference Set – established, genotyped, parentage confirmed, phenotyped in 2015 season | Peach breeders | |
| | | Phenotypic data on soluble solids content and day neutrality in plant materials targeted for root and crown rot resistance screening – obtained | Strawberry breeders | |
| | | Pedigree-Based Analysis software – instruction provided | Crop Breeding Teams | |
| | | Valuable alleles from "RosBREED 1" data sets – identified using Pedigree-Based Analysis software; | DNA-Informed Breeding Team | |
| | | New DNA tests for horticultural quality – developed | Crop Breeding Teams | |
| | **2c.** Compile locus specific DNA information | Genotyping-by-Sequencing data of important individuals – compiled | Breeding and Statistical Genetics Teams | Knowledge of DNA sequence and genome-wide SNP genotypes will allow the confirmation of alleles present in the diverse range of germplasm used in breeding |
| | | Haploblocking analyses using existing high-resolution data (SNP array, Genotyping-by-Sequencing) – initiated | Statistical Genetics Team | |
| | **2d.** Conduct marker-assisted selection for combined traits | Marker-assisted parent selection in apple, peach, cherry, and strawberry breeding programs – conducted | Crop Breeding Teams | Breeders benefit from DNA information for parent and cross selection. Information on marker-assisted parent selection used will provide insights into those DNA tests that are considered high priority and will provide success stories to share widely to the breeding and stakeholder community |
| | | Use of marker-assisted parent selection – tracked | Demonstration Breeders and Extension Team | |

| Objective | Challenge | Plan for Tackling |
|---|---|---|
| **2 Combine Disease Resistance and Horticultural Quality** | For the RosMAP approach, influencing loci in one or more crops may not have genetic variation in the target crop | Use a linkage mapping approach to identify trait loci |

# Table 3: Objective 3 Planned Deliverables for Year 1 (green) and Challenges (blue)

| Objective | Sub-Objective | What | To Whom | Impact |
|---|---|---|---|---|
| **3 Advance Selections with Improved Confidence** | **3a.** Add genetic background effects | Pedigree, phenotypic, and genotypic data for genome-wide selection training populations – compiled and error-checked | Apple, peach, sweet cherry, and strawberry breeders and Statistical Genetics Team | Progeny will be selected and advanced with improved confidence based on knowledge of major and minor loci influencing trait variation |
| | | Selection populations genotyped for major loci – initiated | Apple, peach, sweet cherry, and strawberry breeders and DNA Testing Team | |
| | | Genome-wide predictions – initiated | Statistical Genetics team | |
| | **3b.** Add non-genetic effects | Data sets for genotype x environment x management – compiled | Apple, peach, sweet cherry, and strawberry breeders and Statistical Genetics Team | Progeny will be selected and advanced with improved confidence based on knowledge of the influence of non-genetic factors compared to genetic factors, including the effects of climates/locales and management practices |
| | | Genotypic data to fill data gaps – initiated | DNA Testing and Statistical Genetics Teams | |

| Objective | Challenge | Plan for Tackling |
|---|---|---|
| **3 Advance Selections with Improved Confidence** | **3a.** Accuracy of genome-wide predictions can not be determined as it is affected by linkage disequilibrium, trait heritability, training population size and training and selection population similarity | Testing the genome-wide selection strategy in four crops, with multiple cycles possible in strawberry, will allow for empirical validation over a range of breeding situations |

# Table 4: Objective 4 Planned Deliverables for Year 1 (green) and Challenges (blue)

| Objective | Sub-Objective | What | To Whom | Impact |
|---|---|---|---|---|
| **4 Increase Routine Use of DNA Information** | **4a.** DNA testing | DNA-based diagnostics services for Obj. 1 and 2 – provided | Crop Teams and DNA Testing Team | Demonstration breeders have access to DNA-based diagnostics services; lessons learned for commercial providers |
| | **4b**. Software Support | *Cross Assist* and *Seedling Select* decision-support software for breeders – enhanced, DNA information added | DNA-Informed Breeding Team | Software will serve breeders to make more informed decisions on parent and seedling selection; software will be useful tools for MAB technical training |
| | **4c.** Economics of DNA information use | Case studies of cost-benefit analysis of DNA information use in breeding (Univ. of Minn – apple, WSU - cherry) including cost categories and detailed costs within each – obtained | Socio-Economics Team and apple and cherry breeders | Knowledge of relative costs and benefits of various uses of DNA information in breeding and experiences of new adopters will increase impact of DNA information use in breeding |
| | | Case studies of DNA informed breeding adoption (MSU - peach, WSU - strawberry) – initiated | Socio-Economic Team and peach and strawberry breeders | |
| | **4d.** Technical training in routine use of DNA information in breeding | 2015 DNA-informed breeding workshop and face-to face breeder visits – conducted | DNA-Informed Breeding and Extension Teams | Rosaceae crop breeders benefit from use of DNA information to achieve greater efficiency, accuracy, and creativity culminating in superior cultivar release; knowledge of successes and limitations in DNA-informed breeding adoption identifies strategies and weaknesses to focus future efforts |
| | | Online content for breeders – initiated | DNA-Informed Breeding and Extension Teams | |
| | | Successful adoption of DNA-informed breeding by U.S. rosaceous crop breeders – quantified; Pitfalls and limitations – identified | External Evaluator | |

| Objective | Challenge | Plan for Tackling |
|---|---|---|
| **4 Increase Routine Use of DNA Information** | 4a. Genotyping needs and technologies are constantly changing | Close collaborations with other international users and commercial service providers of genotyping platforms will allow us to meet current and changing genotyping needs of the rosaceous crop community for affordable genotyping capability |
| | **4c**. Cost:benefit analyses of case studies may not apply to other programs | Templates will be provided for breeders to calculate costs and benefits for their own program |

# Table 5: Objective 5 Planned Deliverables for Year 1 (green) and Challenges (blue)

| Objective | Sub-Objective | What | To Whom | Impact |
|---|---|---|---|---|
| **5 Utilize Stakeholder Input** | **5a.** Cultivar adoption case studies | Case studies of strawberry and peach cultivar release – initiated | Socio-Economics Team and strawberry and peach breeders | Insight into decision-making received from peach and strawberry industry members about new elite selections will inform cultivar development and release strategies |
| | **5b.** Industry stakeholder engagement | Activities, outcomes, and impacts communicated at Year 1 Advisory Panel meeting – conducted | Advisory Panel members | Feedback received and needs addressed. Stakeholders value benefits of DNA-informed breeding. Stakeholders use DNA information made available with new cultivar releases to support their adoption decisions |
| | | Outcomes and impacts communicated through electronic media and presentations at industry meetings – delivered | Industry stakeholders | |
| | | Jargon-free material using breeding program specific language and a common project-wide format – developed and delivered | Crop Breeding Teams | |
| | | Stakeholder input through breeding program advisory committees – received | RosBREED Executive Committee | |

| Objective | Challenge | Plan for Tackling |
|---|---|---|
| **5 Utilize Stakeholder Input** | **5a.** Results of case studies may not be widely applicable | Document survey tools, economic models, and analytical methods for other programs to follow |
| | **5a.** Small sample sizes for case studies of cultivar adoption | Supplement case studies with clicker surveys of larger audiences at grower meetings |
| | **5b.** Industry stakeholder participation in communication and engagement opportunities my be low | Stakeholders will be offered repeated, varied opportunities to engage and contribute their feedback and recommendations |

# RosBREED

**Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars**

## Team Leaders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# RosBREED

**Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars**

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| Tom Gradziel (Univ. of California-Davis)<br>tmgradziel@ucdavis.edu | Guido Schnabel (Clemson Univ.)<br>schnabe@clemson.edu |

| Breeder Collaborators | |
|---|---|
| Patrick Moore (Washington State Univ.)<br>moorepp@wsu.edu | William Shane (Michigan State Univ.)<br>shane@msu.edu |

| RosBREED Project Assistants | |
|---|---|
| Audrey Sebolt (Michigan State Univ.)<br>grantzau@msu.edu<br>517.353.0432 | Joan Schneider (Michigan State Univ.)<br>schnei37@msu.edu<br>517.353.0360 |

## International Partners and Nature of Partnership

1. **Centro di Ricerca per la Frutticoltura – Rome, Italy:** Ignazio Verde will provide expertise in peach genomics, genetics, and QTL discovery.

2. **East Malling Research, East Malling, UK - Department of Plant Breeding and Genetics:** Richard Harrison will provide expertise in strawberry genetics and genomics. Felicidad Fernandez will provide expertise in cherry and pear breeding and genetics.

3. **INRA – Breeding & Genetics teams:** The INRA breeding teams will provide parallel expertise in apple, peach, strawberry and cherry breeding and genetics.

   **a**. Unité de Génétique et Amélioration des Fruits et Légumes (UGAFL), INRA CR Avignon, France INRA – Angers: Francois Laurens and team member Charles-Eric Durel will provide expertise in apple breeding and genetics and will collaborate by using common SNP markers. Linkages will be formed with the molecular genetics laboratory of Pauline Lasserre.

   **b.** Unité de Recherche des Espèces Fruitières (UREF), INRA CR Bordeaux, Villenave d'Ornon, France INRA – Bordeaux: Béatrice Denoyes-Rothan will provide expertise in strawberry breeding and genetics and will collaborate by placing the RosBREED SNP markers on the INRA octoploid strawberry map. Elisabeth Dirlewanger will provide expertise in *Prunus* genetics and comparative mapping in the Rosaceae. José Quero Garcia will provide expertise in sweet cherry breeding and genetics and we will collaborate by using common SNP markers.

   **c.** Unité de Génétique et Horticulture (GENHORT), INRA CR Angers, Beaucouze, France INRA – Avignon: Benedicte Quilot-Turion will provide expertise in peach molecular genetics and will collaborate by using common SNP markers. Linkages will be formed with the peach breeding team of Thierry Pascal and Patrick Lambert.

4. **Institut für Pflanzengenetik, Leibniz University Hannover, Germany:** Thomas Debener will provide expertise in rose genetics and genomics including access to a large collection of unpublished ESTs.

5. **Istituto Agraraio San Michele – Biology Department, Trento, Italy:** Riccardo Velasco will provide expertise in genomics and will support RosBREED through the sharing of refinements in the apple genome sequence. Dan Sargent will provide expertise in strawberry genetics and comparative genomics in the Rosaceae.

6. **Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Cabrils, Spain:** Pere Arus will provide expertise in peach genetics and genomics. Amparo Monfort will provide expertise in strawberry genetics and genomics as part of the international strawberry SNP consortium.

7. **Instituto de Investigación y Formación Agraria y Pesquera – Málaga, Spain:** Iraida Amaya will provide expertise in strawberry genetics, genomics, germplasm and breeding.

8. **Plant & Food Research, Palmerston North, 4474, New Zealand:** Sue Gardiner will provide expertise in apple and pear genetics and marker-assisted breeding. David Chagné will provide expertise in apple and pear genetics including genome-wide selection.

9. **University of Chile, Santiago, Chile:** Herman Silva and Lee Meisel will provide expertise in Rosaceae functional genomics and metabolomics through the sharing of peach, sweet cherry, and strawberry sequence data.

# Professional Interests of RosBREED Advisory Panel Members

RosBREED has three Advisory Panels, representing industry, scientific, and extension interests. Panel members broadly represent the diversity of Rosaceae by crop, region, and professional expertise.

## RosBREED Industry Advisory Panel

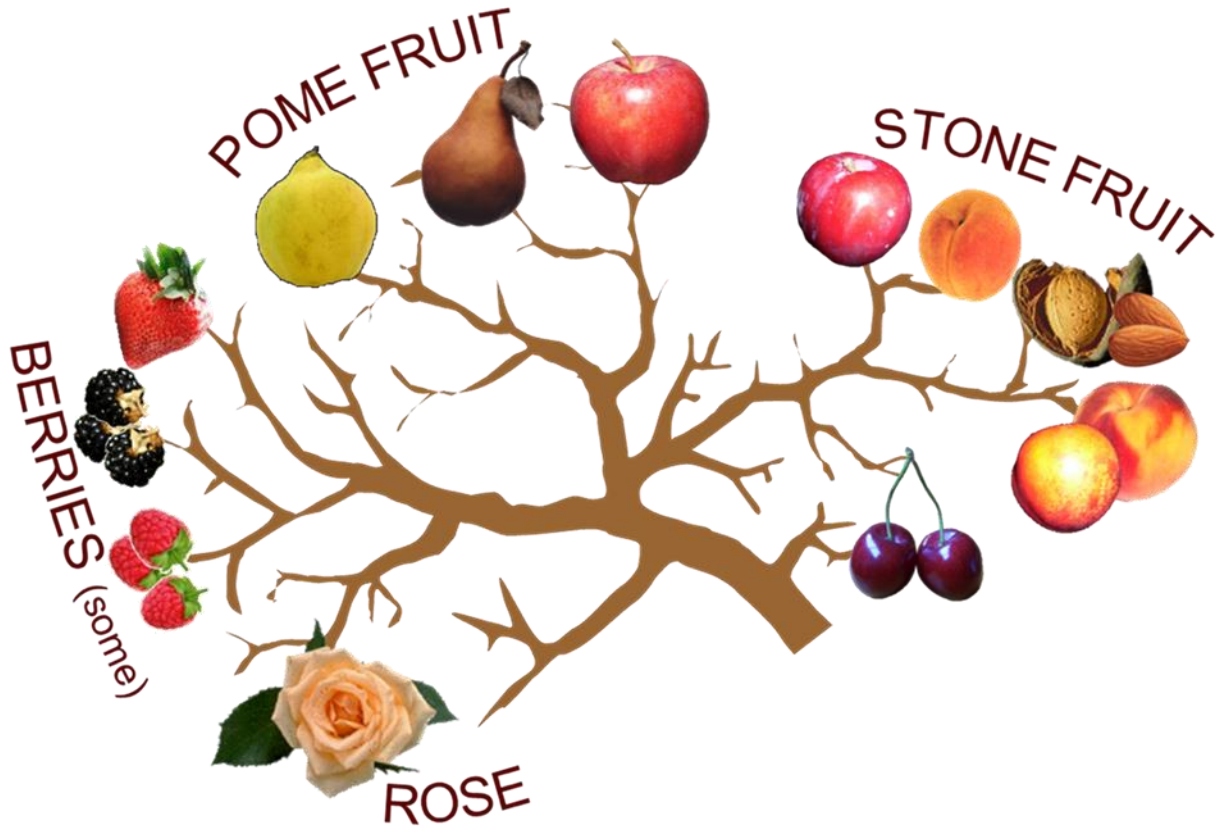
- **Jim Allen:** President
  New York Apple Association, Fishers, NY (www.nyapplecountry.com)
  Board of Trustees, US Apple Association (www.usapple.org)
- **Jen Baugher:** Marketing Associate
  Adams County Nursery, Aspers, PA (www.acnursery.com)
- **Chris Britton:** Partner
  Britton Konynenburg Partners, Modesto CA (www.brittonkonynenburg.com/)
  ex-President Board of Trustees, US Apple Association (www.usapple.org)
- **Chalmers Carr III:** CEO
  Titan Peach Farms, Inc., Ridge Spring, SC (www.titanfarms.com)
  Board of Directors, South Carolina Peach Council (www.scpeach.org)
- **Fred Cook:** Director of R&D Planning and Metrics
  Driscoll's Strawberry Associates, Watsonville, CA (www.driscolls.com)
- **Robert Curtis:** Senior Director, Agricultural Affairs
  Almond Board of California, Modesto, CA (www.Almonds.com)
- **Bill Dodd:** President
  Ohio Fruit Growers Marketing Association, Newcomerstown, OH
  (www.ohioapples.com/ohio_apples_fgma.htm)
  ex-President Board of Trustees, US Apple Association
- **Bob Gix:** Horticulturist
  Blue Star Growers, Cashmere, WA
  Co-Chair, Fresh Pear Research Subcommittee, Pears USA (www.usapears.com)
- **Bruce Grim:** Director
  Washington Marketing Associations, Wenatchee, WA (www.themarketingassociations.org)
  ex-President, Board of Trustees, US Apple Association
- **Philip Korson:** President
  Cherry Marketing Inst., Inc., Lansing, MI (www.choosecherries.com)
- **Dan Legard:** Director
  Research and Education, California Strawberry Commission, Watsonville, CA
  (www.calstrawberry.com)
- **John Lott:** President
  Bear Mountain Orchards, Inc., Aspers, PA
- **Chris Pellett:** Co-owner
  Newflora LLC, Central Point, OR (www.newflora.com)

## RosBREED Scientific Advisory Panel

- **Pere Arús:** Head, Plant Genetics Dept., Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Cabrils, Spain
  Research areas: molecular tools for plant genetics; comparative genomics and application of molecular markers in Rosaceae breeding. (www.irta.cat/ca-ES/Persones/Pagines/105.aspx)
- **Joe Arvai:** Svare Chair in Applied Decision Research, Haskayne School of Business and Institute for Sustainable Energy, Environment, & Economy, University of Calgary
  Research areas: Behavioral decision research and decision support systems (http://decisionlab.ca/people/joe-arvai-ph-d/)
- **Frederick Bliss:** Professor Emeritus, Univ. of California, Davis and Sr. Director, R&D Special Projects, Seminis Vegetable Seeds, Woodland, CA
  Research areas: genomics, genetics, and breeding of fruit and vegetable crops; research administrator in public and private sectors; commercialization of breeding products
- **Robin Buell:** Professor, Dept. of Plant Biology, Michigan State Univ.
  Research areas: genomic aspects of plant biology and plant pathogens; high throughput sequencing, functional genomics, comparative genomics, and bioinformatics (www.plantbiology.msu.edu/faculty/faculty-research/robin-buell/)
- **Lailiang Cheng:** Assoc. Professor, Dept. of Horticulture, Cornell Univ., Ithaca, NY
  Research areas: plant nutrition, fruit physiology, molecular, cellular, and whole plant response to abiotic stress in apple, cherry, grape; undergraduate and graduate education (http://hort.cals.cornell.edu/people/lailiang-cheng)
- **Susan Gardiner:** Principal Scientist, The Horticultural and Food Research Inst. of New Zealand (Plant & Food Research [PFR])
  Research areas: leads Gene Mapping Team integrated with PFR breeders in several Rosaceae crops, including, apple, apple rootstock, pear, peach/nectarine and apricot
- **Kim Hummer:** Supervisory Research Horticulturist, National Clonal Germplasm Repository (Corvallis, OR)
  Research areas: conservation of fruit, nut, and specialty crop genetic resources; ploidy in strawberry species. She also actively studies genetics of a wide range of crops.
- **Dan Kluepfel**: Professor, Dept. of Plant Pathology, UC Davis, CA.
  Research areas: research focuses on bacterial diseases of almonds and walnuts, specifically crown gall disease. (http://plantpathology.ucdavis.edu/?story=1033)
- **Brad Rickard:** Asst. Professor, Dept. of Agricultural Sciences, Cornell Univ.
  Research areas: economic implications of policies, innovation, and industry-led initiatives applied to agricultural and food markets (http://dyson.cornell.edu/people/profiles/rickard.php)
- **Carolyn Ross:** Assoc. Professor, Dept. of Food Science, Washington State Univ.
  Research areas: sensory analysis and consumer preferences of fruit and fruit products, including fresh and processed apple, pear, and cherry and wine (http://sfs.wsu.edu/personnel/faculty-staff/ross-c/)
- **Phil Simon:** Research Geneticist, USDA-ARS and Professor, Dept. of Horticulture, Univ. of Wisconsin-Madison.
  Research areas: vegetable breeding and genetics; biochemistry of culinary and nutritive factors, terpenoids, and sugars in carrots and garlic. (www.ars.usda.gov/pandp/people/people.htm?personid=5186)
- **Chang-Lin Xiao**: Supervisory Research Plant Pathologist. USDA-ARS, Parlier CA
  Research areas: biology, epidemiology, and management of diseases of fruit crops with an emphasis on postharvest diseases.
  (www.ars.usda.gov/pandp/people/people.htm?personid=47587)

## RosBREED Extension Advisory Panel

- **David Eddy**: Editor, American/Western Fruit Grower, MeisterMedia, Willoughby OH
  Professional interests: Ag journalism, print and electronic communication
  (www.growingproduce.com/author/david-eddy/)
- **Peter Hirst:** Professor, Dept. of Horticulture, Purdue Univ.
  Professional interests: tree fruit production systems and physiology, physiological genetics of flowering and fruit development in Rosaceae; state Extension specialist; undergraduate and graduate education
  (https://ag.purdue.edu/hla/Pages/Profile.aspx?strAlias=hirst&intDirDeptID=16)
- **David Karp:** Associate, Agricultural Experiment Station, UC Riverside
  Professional interests; freelance food journalist and photographer
- **Ron Perry:** Professor, Dept. of Horticulture, Michigan State Univ.
  Professional interests: extension and research in cherry and apple orchard systems
  (http://www.hrt.msu.edu/ronald-perry/pg7)
- **Clark Seavert**: Professor & Director of the NW Agribusiness Executive Seminar Department of Agricultural & Resource Economics, Oregon State Univ.
  Professional interests: assessment and advancement of technologies that increase profitability and feasibility in commercial agriculture, with the aim of aligning business model innovation strategies to existing and future technologies.
  (http://arec.oregonstate.edu/seavert)
- **Chris Watkins:** Professor, Dept. of Horticulture, Cornell Univ.,
  Assoc. Director for Cornell Cooperative Extension
  Professional interests; postharvest physiology and management of apple, pear, peach, and cherry; state-wide agricultural extension activities
  (http://hort.cals.cornell.edu/people/christopher-watkins)



## Discussion Questions for Break-out Session

**Q1 *Breeding-Industry Interface***

Across rosaceous crops, the use of DNA information is already or will soon be routine. DNA information gives breeders more control when they select for or against particular phenotypes. Given that DNA-informed breeding is a new, constantly-evolving technology, and given that breeding programs are partnerships between the breeding team and their industry stakeholders… What are the challenges and opportunities for RosBREED to help make these partnerships more effective?

**Q2 *Use of DNA Information by Breeders***

Breeding programs have increasing access to new levels of DNA information – from dozens of significant QTLs to all the rest of the crop's genetic background. They have an increasing understanding of the relative contribution of non-genetic effects. They have access to advanced biometric tools. How can an appropriate amount of this information array be integrated into what are mostly traditional breeding programs within the timeframe of RosBREED 2?

- Via our demonstration breeders with a few great success stories?
- Via first ensuring U.S. Rosaceae breeders are using information on at least a few major QTLs before trying to sell the more complex scenarios?
- Others?

**Q3 *Genomics Research***

Is RosBREED best utilizing the outcomes, expertise, and datasets of worldwide Rosaceae genomics research? How can we better synergize?

**Q4 *Project Outreach***

Given that the primary extension audiences are U.S. Rosaceae breeding and industry stakeholders, what are the most useful outreach avenues to achieve the goals described in the other three discussion questions? How can these avenues be most effectively employed?

- RosBREED web site?
- Quarterly Newsletter?
- eXtension?
- Social media?
- Annual RosBREED Advisory Panel meetings?
- Commodity group meetings?
- Individual breeding program interactions with their industries and other breeders?
- Others?