



RosBREED

Annual Project Report



United States
Department of
Agriculture

National Institute
of Food and
Agriculture

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

RosBREED Advisory Panel
Annual Meeting
January 12, 2017
San Diego, CA

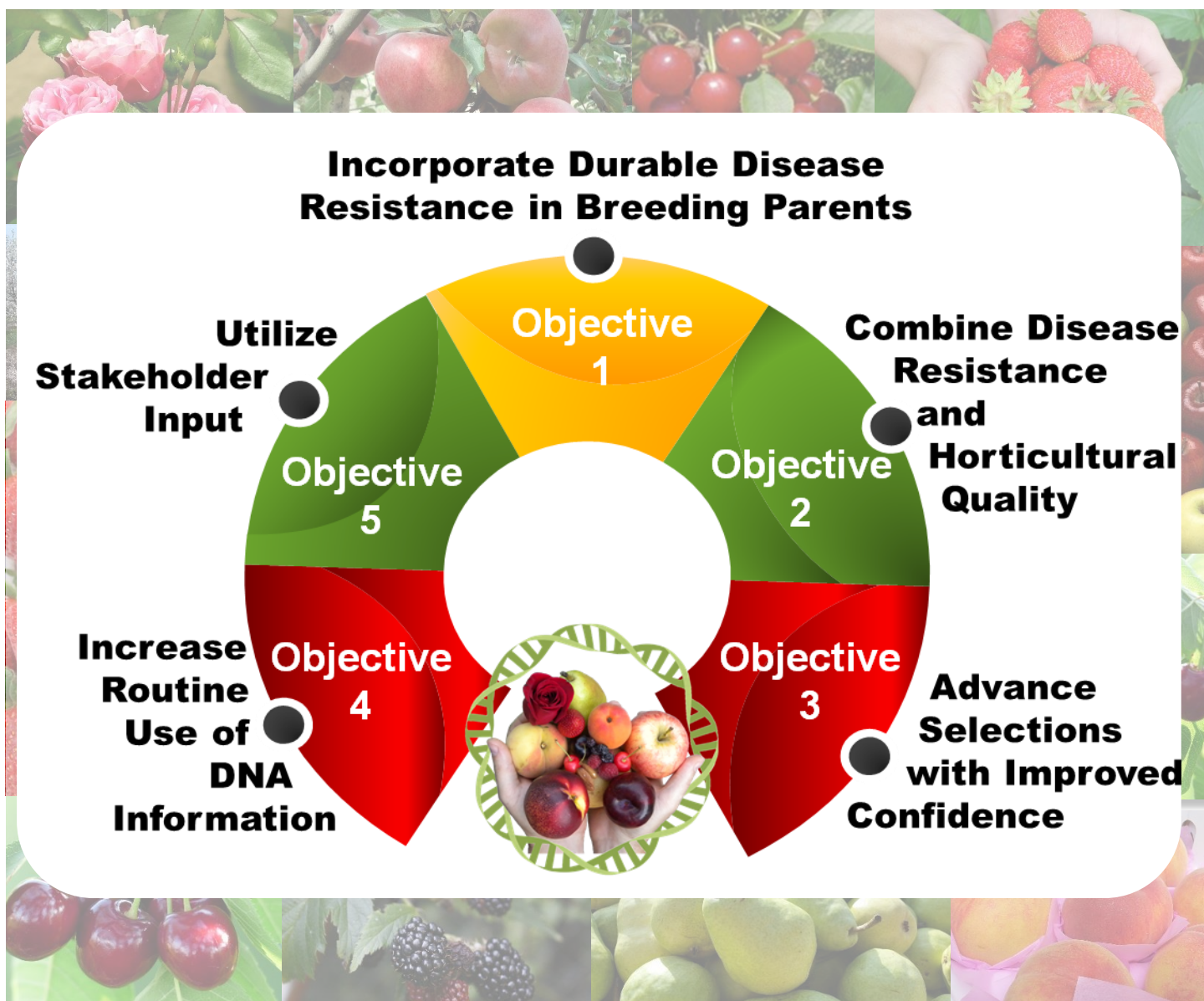




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Agenda

Thu, Jan 12, 2017
Marina Ballroom
Hilton San Diego Airport, 1960 Harbor Island Dr., San Diego, Calif.

Start	End	Audience/ group	Presenter/ moderator	Title
7:30	8:00	Continental breakfast		
8:00		All	Amy lezzoni	Introductions and Agenda
8:30		All	Amy lezzoni	Project overview
8:50		All	Team Leaders	Obj. 1: Incorporate durable disease resistance into breeding parents
9:20		All	Team Leaders	Obj. 2: Combine disease resistance and horticultural quality
9:40		All	Team Leaders	Obj. 3: Advance selections with improved confidence
10:00	10:30	Break		
10:30		All	Team Leaders	Obj. 4: Increase routine use of DNA information in rosaceous crop breeding
11:00		All	Team Leaders	Obj. 5: Utilize stakeholder input
11:30		All	Amy lezzoni	Budget
11:45		All	Amy lezzoni	Charge for afternoon breakout groups
12:00	1:30	Lunch		
1:30	2:45	Breakout groups by crop	Group 1	Pome Fruit (Marina Ballroom)
			Group 2	Stone Fruit (Spinnaker Room)
			Group 3	Berry and Rose (Port Room)
2:45	3:15	Break		
3:15	4:00	All	Breakout group moderators	Report-outs & discussion – next steps/action items
4:00	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



Team Leaders

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RosBREED Team Members

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Breeder Collaborators

Patrick Moore (Washington State Univ.) moorepp@wsu.edu	William Shane (Michigan State Univ.) shane@msu.edu
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RosBREED Project Assistants

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International Partners and Nature of Partnership

1. **Centro di Ricerca per la Frutticoltura, Rome, Italy:** Ignazio Verde provides expertise in peach genomics, genetics, and QTL discovery.
2. **Department of Plant Breeding and Genetics, East Malling Research, East Malling, UK:** Richard Harrison provides expertise in strawberry genetics and genomics. Felicidad Fernandez provides expertise in cherry and pear breeding and genetics.
3. **INRA – Breeding & Genetics teams:** The INRA breeding teams 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 Beauouze, France**
INRA – Angers: Francois Laurens and team member Charles-Eric Durel provide expertise in apple breeding and genetics and collaborate by using common SNP markers. Linkages are formed with the molecular genetics laboratory of Pauline Lasserre.
 - b. **Unité de Recherche des Espèces Fruitières (UREF), INRA CR, Villenave d'Ornon, France**
INRA – Bordeaux: Béatrice Denoyes-Rothan provides expertise in strawberry breeding and genetics and collaborates by placing the RosBREED SNP markers on the INRA octoploid strawberry map. Elisabeth Dirlwanger provides expertise in *Prunus* genetics and comparative mapping in the Rosaceae. José Quero-Garcia provides expertise in sweet cherry breeding and genetics and we are collaborating by using common SNP markers.
 - c. **Unité de Génétique et Horticulture (GENHORT), INRA CR, Avignon, France**
INRA – Avignon: Benedicte Quilot-Turion provides expertise in peach molecular genetics and collaborates by using common SNP markers. Linkages are formed with the peach breeding team of Thierry Pascal and Patrick Lambert.
4. **Institut für Pflanzengenetik, Leibniz University Hannover, Germany:** Thomas Debener provides expertise in rose genetics and genomics including access to a large collection of unpublished ESTs.
5. **Istituto Agrario San Michele, Biology Department, Trento, Italy:** Riccardo Velasco provides expertise in genomics and supports RosBREED through the sharing of refinements in the apple genome sequence.
6. **Institut de Recerca i Tecnologia Agroalimentàries (IRTA), Cabrils, Spain:** Pere Arús provides expertise in peach genetics and genomics. Amparo Monfort provides 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 provides expertise in strawberry genetics, genomics, germplasm and breeding.
8. **Plant & Food Research, Palmerston North, New Zealand:** Sue Gardiner provides expertise in apple and pear genetics and marker-assisted breeding. David Chagné provides expertise in apple and pear genetics, including genome-wide selection.
9. **University of Chile, Santiago, Chile:** Herman Silva and Lee Meisel 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

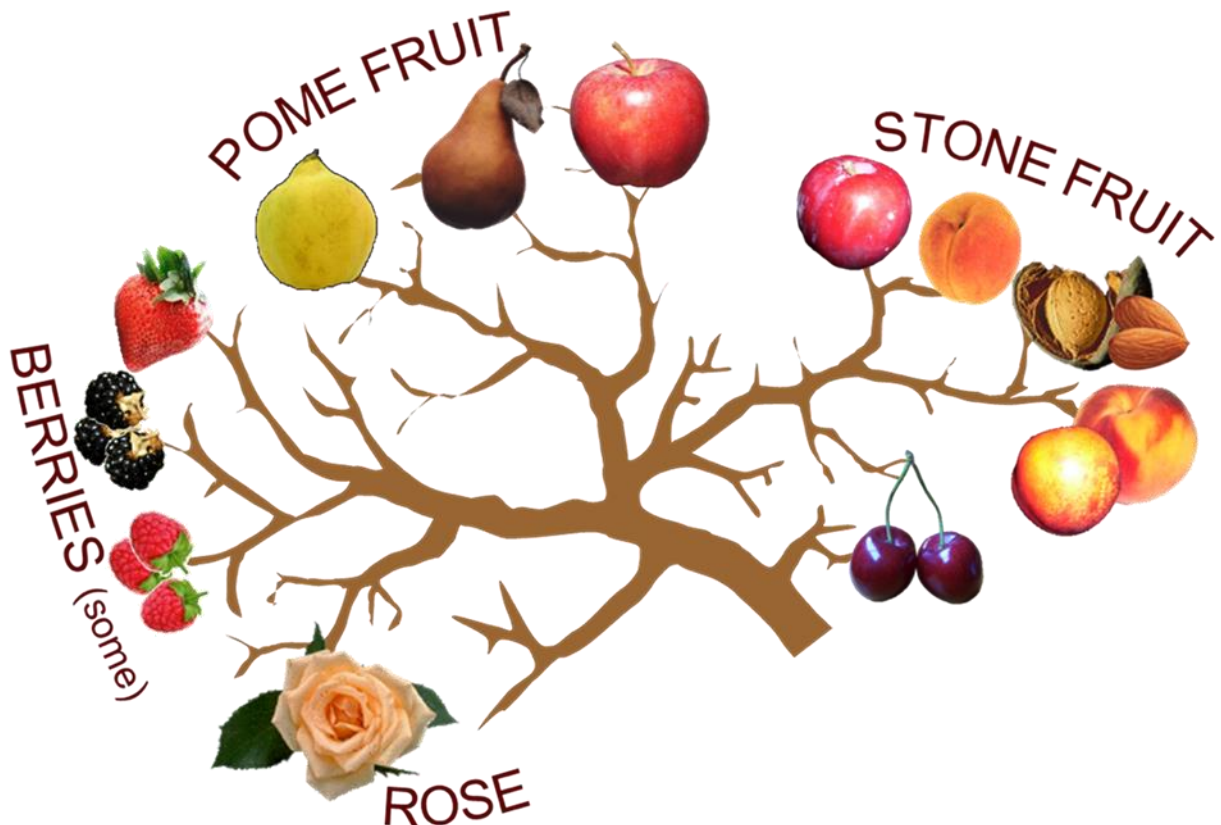
- **Jim Allen:** President
New York Apple Association, Fishers, NY (www.nyapplecountry.com)
Board of Trustees, US Apple Association (www.usapple.org)
- **Jen Baugher:** Marketing Associate
Adams County Nursery, Aspers, PA (www.acnursery.com)
- **Chris Britton:** Partner
Britton Konynenburgh Partners, Modesto CA (www.brittonkonynenburgh.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)
- **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
- **Carlos Fear:** Director of Consumer Lab and Molecular Genetics
Driscoll's Strawberry Associates, Watsonville, CA (www.driscolls.com)
- **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:** Max McGraw Professor of Sustainable Enterprise and Director, Erb Institute, University of Michigan, Ann Arbor, MI
Research areas: Behavioral decision research and decision support systems (www.snre.umich.edu/profile/joseph_Arvai)
- **Frederick Bliss:** Professor Emeritus, Univ. of California, Davis and Sr. Director (ret.), 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., East Lansing, MI
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:** 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, USDA-ARS National Clonal Germplasm Repository, Corvallis, OR
Research areas: conservation and genetics of fruit, nut, and specialty crops; ploidy in strawberry species..
- **Dan Kluepfel:** Professor, Dept. of Plant Pathology, UC Davis, CA
Research areas: bacterial diseases of almonds and walnuts, specifically crown gall. (<http://plantpathology.ucdavis.edu/?story=1033>)
- **Brad Rickard:** Assoc. Professor, Dept. of Agricultural Sciences, Cornell Univ., Ithaca, NY
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, Wash. State Univ., Pullman, WA
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, Madison, WI
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., West Lafayette, IN
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, Riverside, CA
Professional interests: freelance food journalist and photographer
- **Ron Perry:** Professor, Dept. of Horticulture, Michigan State Univ., East Lansing, MI
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., Corvallis, OR
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, Ithaca, NY
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>)



RosBREED

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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 USDA-NIFA 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, remains elusive.

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

What is our vision?

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

What does success look like?

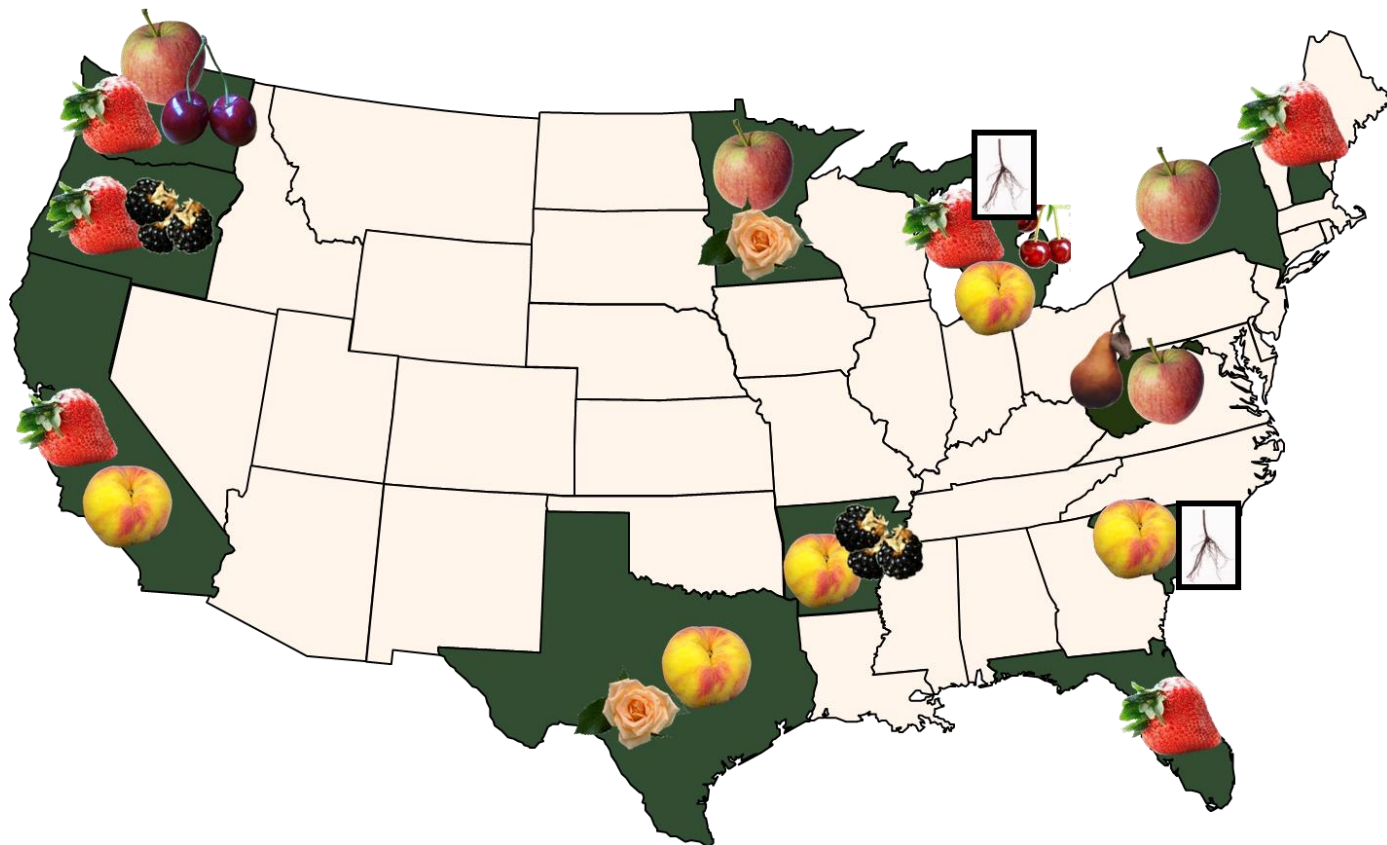
- Consumers are satisfied, repeat customers
- Rosaceous crop industries are more profitable and sustainable
- Plant breeding programs are more efficient and effective

RosBREED

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Targeted Crops, Breeders, & Diseases



Apple: 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 & Margaret Worthington)
- Texas A&M (David Byrne)
- Univ. of California Davis (Tom Gradziel)
- Michigan State Univ. (William Shane)

Pear: Fire blight

- USDA-ARS Kearneysville (Jay Norelli)

Sweet cherry: Powdery mildew

- Washington State Univ. (Cameron Peace)

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)

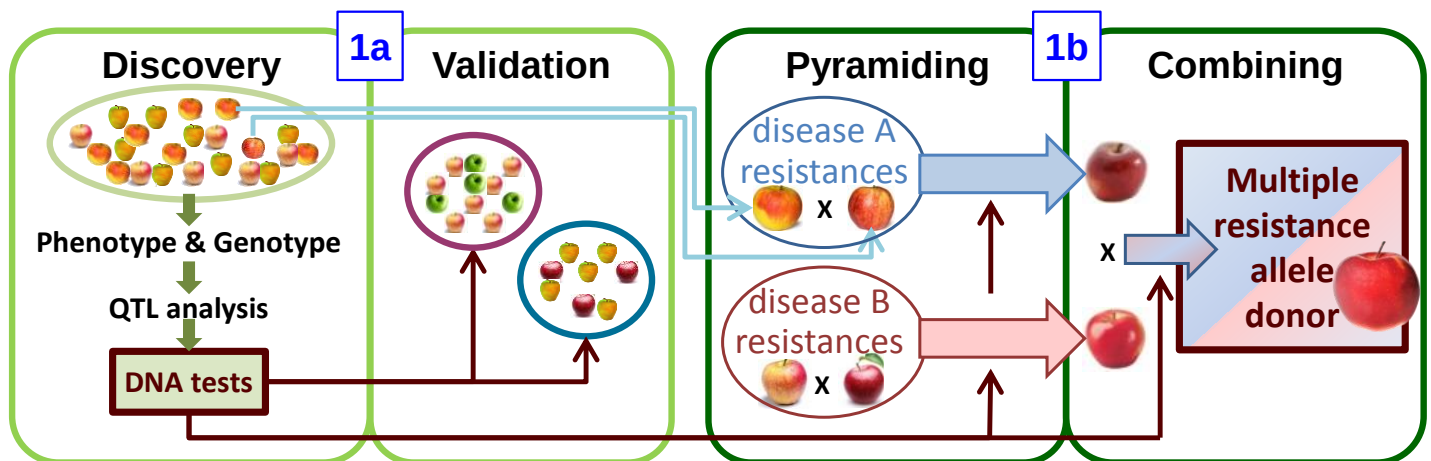
Blackberry: Fruit sweetness. This is the overwhelming need as there is not a major disease threat

- Univ. of Arkansas (John Clark & Margaret Worthington)
- 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 alleles and develop and validate DNA tests for disease resistance by QTL analysis

1b Incorporate these alleles by marker-assisted introgression into breeding parents, which we call “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** was initiated in Year 1 and will be completed at the end of Year 3 for pear. **1b** started in Year 1 for apple, Year 2 for peach, strawberry and tart cherry with resistance alleles pyramided or combined from at least two sources accomplished by Year 5.



Jay Norelli



Guido Schnabel

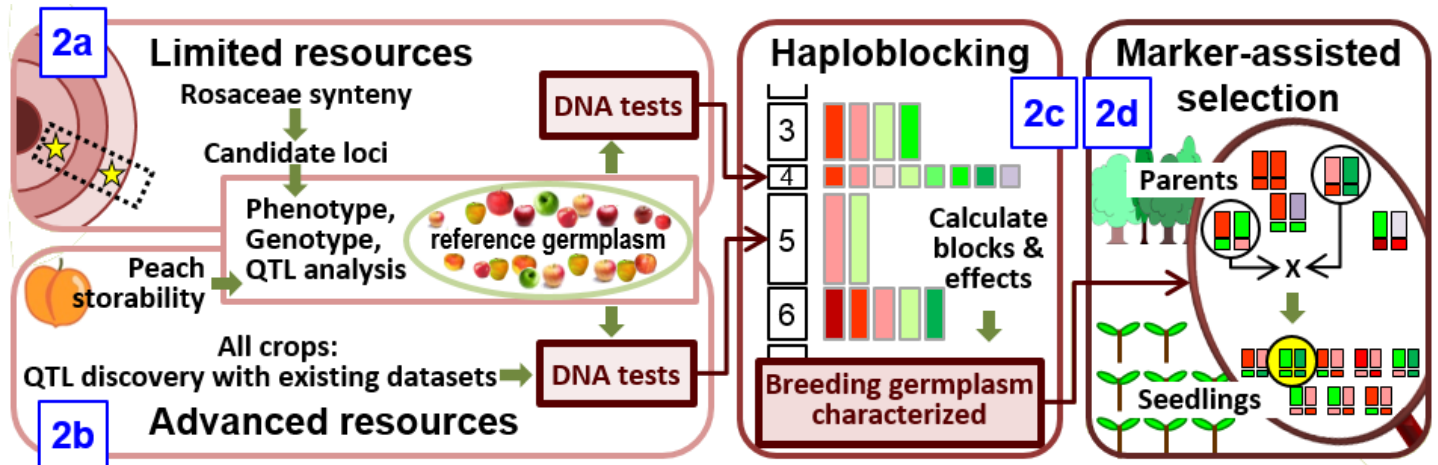


Kelly Ivors

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 (haploblocking) 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** was initiated in Year 1, with completion in Year 3. **2d** will be accomplished in Years 1-5 (apple, peach, strawberry, cherry) or Years 4-5 (rose, blackberry, pear).



Dorrie Main

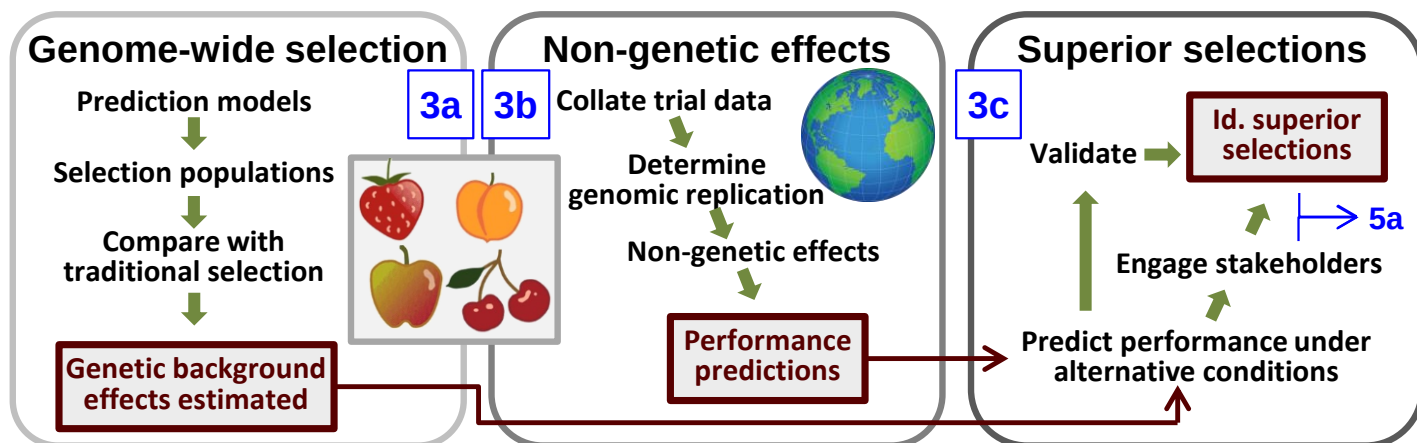
Carlos Crisosto

Amy Lawton-Rauh

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, $G \times E$) 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** was initiated in Year 1 with data compilation and analysis completed in Year 4. **3c** will be conducted in Year 4.



Vance Whitaker



Rex Bernardo

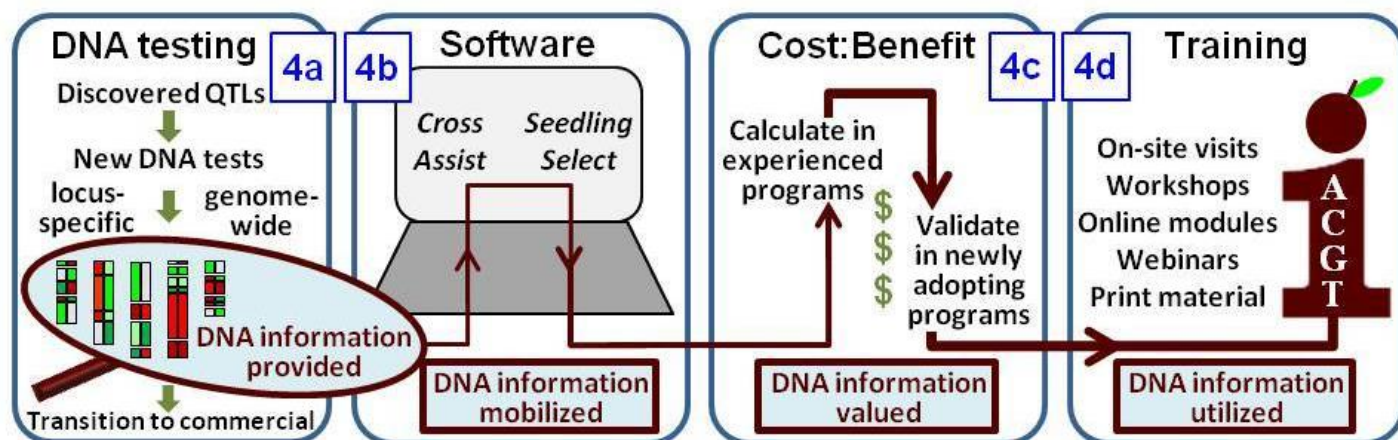


Craig Hardner

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 to 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.

Timeline: **4a** was initiated in Year 1 and tool development will continue until the end of Year 5. **4b** software enhancement was completed in Year 1; information integration will be started in Year 1 and will end in Year 5; routine DNA testing will transition to commercial service providers after Year 3. **4c** cost: benefit analyses began 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.



Nahla Bassil



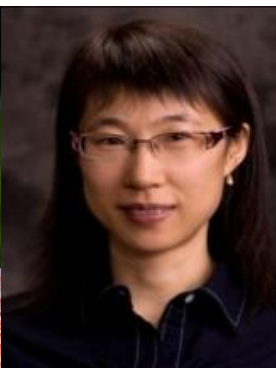
Chris Saski



Cameron Peace



Jim McFerson



Chengyan Yue



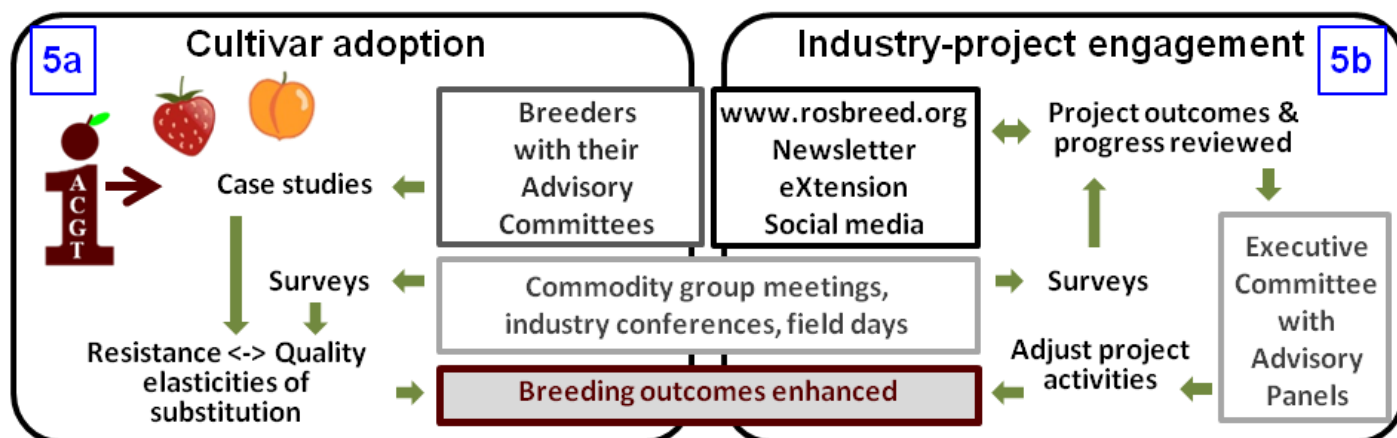
Vicki McCracken



Karina Gallardo

OBJECTIVE 5 Utilize Stakeholder Input

The impact of new cultivars will be maximized with industry stakeholder input into cultivar trait priorities and improved predictability of commercial performance. 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 are being engaged in project outcomes, evaluation, and adjustments.

Timeline: **5a** will be initiated in Year 2, with surveys conducted in Years 2 and 3. **5b** stakeholder activities will follow an annual timeline for all five years of recurring (and some ad hoc) meetings



Jim McFerson



Des Layne



Vance Whitaker



Lisa Wasko DeVetter



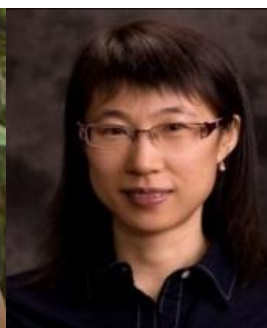
Greg Reighard



Vicki McCracken



Karina Gallardo



Chengyan Yue



Ksenija Gasic

Table 1: Objective 1 – Deliverables for Year 2

Objective	Sub-Objective	What	To Whom	Impact
1 Incorporate Durable Disease Resistance in Breeding Parents	1a. Disease resistance allele discovery and validation	Disease phenotypic data for 4100 plant materials in season 2016 – completed: apple fire blight 1754; cherry leaf spot 442; cherry powdery mildew 50+500; peach bacterial spot 245; peach fruit brown rot 525; rose black spot 959; strawberry bacterial leaf spot, anthracnose crown rot, and <i>Phytophthora</i> crown rot 700	Crop Breeding Teams and Pathology Team	These plant materials and their phenotypic and genotypic data are resulting in discovery of loci associated with disease resistance and enable development of DNA tests for breeding application
		Genotypic data of population subsets phenotyped for disease resistance – obtained: rose black spot; cherry leaf spot	Crop Breeding Teams and Pathology Team	
		Major-effect locus discovery – successful, published, and now targeted for validation: apple: 1-2 scab resistance loci identified from Honeycrisp (LG1 and possibly LG15); peach: 2 published brown rot QTLs targeted for validation; pear: 2 published pear fire blight QTLs (LGs 2 and 4) targeted for validation	Pathology Team and DNA-Informed Breeding Team	
	1b. Pyramid and combine disease resistance alleles	DNA tests – developed: apple: Honeycrisp-derived LG1 scab resistance locus diagnosed with existing SSR test called Chvf, blue mold resistance from <i>M. sieversii</i> (LG3), foliar powdery mildew resistance from White Angel (LG8); strawberry- bacterial angular leaf spot and <i>Phytophthora</i> root rot resistance]	Pathology Team and DNA-Informed Breeding Team	
		Offspring created from crosses to pyramid or combine disease resistance alleles – obtained: strawberry: 420 offspring to combine resistances for anthracnose and <i>Phytophthora</i> crown rot, and anthracnose with bacterial angular leaf spot; tart cherry: 500 offspring to pyramid multiple cherry leaf spot resistances Crosses to pyramid or combine disease resistance alleles – made: apple: pyramid multiple scab resistances, combine resistances to scab and fire blight; peach: combine resistances to brown rot and bacterial spot	Crop Breeding Teams	
		Genotyping to identify offspring with multiple resistance loci – initiated: strawberry resistances to <i>Colletotrichum</i> , <i>Phytophthora</i> , <i>Xanthomonas</i> and bacterial angular leaf spot	Crop Breeding Team and DNA-Informed Breeding Team	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

Table 1: Objective 1 –Year 2 Challenges (blue) and Year 3 Planned Deliverables (purple)

Objective	Challenge	Plan for Tackling
1 Incorporate Durable Disease Resistance in Breeding Parents	Apple scab phenotyping failed because of powdery mildew outbreak in greenhouse	Start with new seedlings, new inoculum, and cleaned greenhouse
	DNA test for apple scab resistance locus on LG15 not developed because resistance and susceptible SNP haplotypes are identical	Fine mapping to identify new diagnostic SNPs
	DNA test for angular leaf spot in strawberry gave unreliable predictions	New DNA test is being designed
	Retirement of pear breeder	Jay Norelli to assume responsibility to phenotype pear for fire blight; SSC removed

Objective	Sub-Objective	What	To Whom	Impact
1 Incorporate Durable Disease Resistance in Breeding Parents	1a. Disease resistance allele discovery and validation	Standardized disease phenotypic data of plant materials for 2017 season – obtained [strawberry root and crown rots, apple scab, peach bacterial spot, sweet cherry fruit powdery mildew, rootstocks Armillaria root rot]	Crop Breeding Teams and Pathology Team	These plant materials and their phenotypic and genotypic data will continue to lead to discovery of loci associated with disease resistance and enable development of DNA tests for breeding application
		Genome scan data of disease-phenotyped families – obtained [genotypic data: peach genome scan data 9+9K SNP array on 1488 individuals of new Crop Reference Set]	Crop Breeding Teams and DNA Testing Team	
		QTL discovery for those diseases/donor sources where phenotyping and genotyping have been completed – ongoing [apple scab and fire blight, peach bacterial spot and brown rot, cherry leaf spot]	Crop Breeding Teams and Crop Post-Docs	
	1b. Pyramid and combine disease resistance alleles	New offspring created from crosses to pyramid and combine disease resistance alleles – obtained [peach: combine resistances for fruit bacterial spot and brown rot] Pyramiding/combining families genotyped with disease-resistance DNA tests to advance resistant individuals – ongoing [various crops and diseases]	Crop Breeding Teams and Crop Post-Docs	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

Table 2: Objective 2 – Deliverables for Year 2

Objective	Sub-Objective	What	To Whom	Impact
2 Combine Disease Resistance and Horticultural Quality	2a. Horticultural quality allele discovery and validation – RosMAP	Rosaceae-wide sweetness QTL synteny – 3 loci identified	DNA Testing Team	RosMAP will provide a shortcut to identifying valuable trait loci by leveraging knowledge of common ancestral origin across rosaceous genera, demonstrated here by sweetness in blackberry
		Blackberry families parentage verification then phenotyping (n=255 offspring) – completed, genotyping now underway	Berry Fruit Breeding and DNA Testing Teams	
	2b. Horticultural quality allele discovery and validation – advanced resources	Advanced Peach Crop Reference Set (n=741) postharvest phenotyping for Year 2 – completed (71,782 data points)	Peach breeders	Rosaceae breeders will have new trait loci to learn the allelic combinations of their parents and from which to request new DNA tests that could reveal trait-associated alleles in their seedling families
		Advanced Peach Crop Reference Set genotyping – DNA extraction completed	DNA-Informed Breeding Team (4a)	
		Curation of “RosBREED 1” datasets of cherry, peach, apple, strawberry – completed, SNP datasets most recently, manuscripts in preparation	DNA-Informed Breeding Team, Crop Postdocs, students	
		Pedigree-Based Analysis software support – provided	Crop Breeding Teams	
		New QTL discovery from “RosBREED 1” datasets – successes: strawberry: remontancy large-effect, smaller-effect QTLs for SSC, firmness, fruit weight, pH, TA; apple: soft scald/soggy breakdown disorder (LG2); sweet cherry: maturity time	DNA-Informed Breeding Team (for DNA test dev., 4a)	
	2c. Compile locus-specific DNA information across the genome	Genotyping-by-Sequencing data of important individuals – compiled (peach), analyzed (apple)	Crop Breeding, DNA-Informed Breeding, and DNA Testing Teams	Knowledge of allelic variation across the genome in discrete blocks will allow the characterization of alleles present in diverse breeding germplasm at a resolution that breeders can easily manage
		Pilot haploblocking analysis using the <i>Ma</i> locus in apple – completed		
		Pilot pedigree-based haploblock utility study focusing on the G2 QTL hotspot in sweet cherry – in progress		

Table 2: Objective 2 – Deliverables for Year 2 cont.

Objective	Sub-Objective	What	To Whom	Impact
2 Combine Disease Resistance and Horticultural Quality	2d. Conduct marker-assisted selection for combined traits	Marker-assisted parent and seedling selection according to RosBREED's 3 DNA Testing Portals' crop groups – completed: Rosoideae & Pear: UF strawberry: SSC n=288, aroma (mesifurane/gamma-decalactone) n=25, angular leaf spot n=12; MSU strawberry: remontancy n=22; USDA-ARS Corvallis strawberry: remontancy n=160; WSU strawberry: remontancy n=110 <u>Apple & Cherry</u> : UMN apple: crispness, ethylene/storability, firmness, scab res n=168+2202; MSU tart cherry: flesh color n=37; USDA-ARS Kearneysville apple: crispness, acidity, firmness, ethylene/storability, fructose content, blue mold res, skin color, bitter pit n=246; Cornell Univ apple: crispness, acidity, firmness, ethylene/storability, fructose content, scab res, bitter pit n=606; Ohio State Univ apple: crispness, acidity, firmness, ethylene/storability, fructose content, scab res, bitter pit n=94; WSU apple: crispness, ethylene/storability n=6742; WSU sweet cherry: foliar powdery mildew, self-fertility, maturity time, and fruit color, cracking, size, and firmness n=54 (elite selections) <u>Peach</u> : Clemson peach: bacterial spot fruit res n=5600; MSU peach: bacterial spot res n=75	Crop Breeding Teams	Breeders will benefit from DNA information for parent and seedling selection. Information on parents will determine which DNA tests are suitable for use on families; information on greenhouse-grown families will identify optimal sets of seedlings for field-planting. Experiences will underlie new success stories of enhanced breeding efficiency, accuracy, creativity, and pace to share widely to the breeding, industry stakeholder, and allied scientist communities
		Use and experiences of marker-assisted parent and seedling selection – tracked	Administration, DNA-Informed Breeding, and Extension Teams	

Table 2 cont.: Objective 2 – Challenges (blue) and Year 3 Planned Deliverables (purple)

Objective	Challenge	Plan for Tackling		
2 Combine Disease Resistance and Horticultural Quality	Time needed to correct errors in apple data set, with 10–20% of the SNPs requiring manual scoring across multiple families	Strategy put into place (and being written in manuscript) to categorize and selectively exclude individual SNPs from the dataset; use equivalent approach for peach and cherry too		
	Time needed to choose an additional 9000 SNPs for the enhanced cherry array	Be patient; RosBREED’s cherry research doesn’t desperately need the new data		
Objective	Sub-Objective	What	To Whom	Impact
2 Combine Disease Resistance and Horticultural Quality	2a. Horticultural quality allele discovery and validation – RosMAP	Candidate loci for sweetness in blackberry – tested blackberry	DNA Testing Team, Blackberry breeding team	This case study for the RosMAP candidate locus approach will determine how readily a less-genomics-resourced crop like blackberry can be fast-tracked to having trait-predictive DNA tests by leveraging shared ancestry and resources of other Rosaceae crops
	2b. Horticultural quality allele discovery and validation – advanced resources	Advance Peach Crop Reference Set QTL discovery for post-harvest fruit quality – large-effect loci identified and alleles characterized	DNA-Informed Breeding Team (for DNA test dev., 4a)	
		Pedigree-Based Analysis software instruction – provided	Crop Postdocs and Crop Breeding Teams	Rosaceae breeders will have new trait loci to learn the allelic combinations of their parents and from which to request new DNA tests that could reveal trait-associated alleles in their seedling families
		Valuable alleles from “RosBREED 1” data sets – identified using Pedigree-Based Analysis software	DNA-Informed Breeding Team (for DNA test dev., 4a)	
	2c. Compile locus specific DNA information	Haploblock construction and characterization – completed	DNA-Informed Breeding and DNA Testing Teams	Knowledge of allelic variation across the genome in discrete blocks will allow the characterization of alleles present in diverse breeding germplasm at a resolution that breeders can easily manage
		Functional utility added to haploblocks – in progress		
	2d. Conduct marker-assisted selection for combined traits	Marker-assisted parent selection and marker-assisted seedling selection genotyping provided for apple, peach, cherry, and strawberry breeding programs – conducted	Crop Breeding Teams	Breeders will benefit from DNA information for parent and seedling selection. Information on parents will determine which DNA tests are suitable for use on families; information on greenhouse-grown families will identify optimal sets of seedlings for field-planting. Experiences will underlie new success stories of enhanced breeding efficiency, accuracy, creativity, and pace to share widely to the breeding, industry stakeholder, and allied scientist communities
		Marker-assisted parent selection genotyping provided for rose, blackberry, and pear – conducted		
		Use and experiences of marker-assisted parent selection and marker-assisted seedling selection – tracked	Administration, DNA-Informed Breeding, and Extension Teams	

Table 3: Objective 3 - Deliverables for Year 2 (green) and Challenges (blue)

Objective	Sub-Objective	What	To Whom	Impact
3 Advance Selections with Improved Confidence	3a. Add genetic background effects	Apple: Predictive model – developed and tested; modification of model to include major-effect loci (QTLs) as fixed effects – underway; phenotypic evaluation for post-harvest traits of test populations – underway	Apple breeders and Statistical Genetics Team	Offspring will be selected and advanced with improved confidence based on knowledge of significant and non-significant loci influencing trait variation
		Peach: Data set – transferred to Statistical Genetics Team, preliminary analyses underway	Peach breeders and Statistical Genetics Team	
		Strawberry: Genome-wide selection strategy for parent selection for fruit weight and early marketable yield – designed and adopted in UF program	Strawberry breeders and Statistical Genetics Team	Adoption of genome-wide predictions for parent selection in strawberry has resulted in reduction of the breeding cycle from three years to two years
		Predictive models (all crops) including dominance effects – underway	Statistical Genetics Team	
	3b. Add non-genetic effects	Pipeline to improved data management efficiency in Genome Database for Rosaceae – developed Data compilation from ~20 trials around the world – ongoing, status: apple n = 2359, sweet cherry n = 611 Analysis concepts – developed, tested, and presented on sweet cherry maturity date Genome-scanning needs to fill data gaps – ongoing	Data Management Team Apple, peach, sweet cherry, and strawberry breeders and Statistical Genetics Team Statistical Genetics Team DNA Testing and Statistical Genetics Teams	Offspring 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/locations and management practices

Objective	Challenge	Plan for Tackling
3 Advance Selections with Improved Confidence	Accurately measuring and predicting non-genetic effects and their interactions with genetic effects requires more existing marker data than is currently available on germplasm collections worldwide	Continuing to identify most important germplasm collections and individuals for filling marker data gaps in each crop will make analyses much more efficient and effective
	Placing orders for SNP genome scans – convoluted ordering process	Do what needs to be done – place orders as early as possible knowing it will take months to receive results; in meantime prepare a streamlined data curation pipeline

Table 3 cont.: Objective 3 – Year 3 Planned Deliverables

Objective	Sub-Objective	What	To Whom	Impact
3 Advance Selections with Improved Confidence	3a. Add genetic background effects	Apple: Model tested using major-effect loci (QTLs) as fixed effects; selection populations genotyped and used for model testing	Apple breeding team and Statistical Genetics Team	Offspring will be selected and advanced with improved confidence based on knowledge of significant and non-significant loci influencing trait variation
		Peach: Prediction models tested on training population; selection populations genotyped and phenotyped	Peach breeding team and Statistical Genetics Team	
		Strawberry: Prediction model tested including dominance effects; testing of prediction models for within-family seedling selection	Strawberry breeding team and Statistical Genetics Team	
	3b. Add non-genetic effects	Genome-scan data to fill data gaps – completed	DNA Testing and Statistical Genetics Teams	Offspring 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
		Data sets for genotype x environment x management compiled – completed	Apple, peach, sweet cherry, and strawberry breeding teams and Statistical Genetics Team	
		Calculation of genetic and non-genetic sources of variation and their interactions – well underway	Statistical Genetics Team and internationally collaborating partners	
	3c. Advance superior selections	Genotype advanced selections – initiated	DNA Testing and Crop Breeding Teams	Selections will be advanced toward commercial release or discarded with improved confidence based on knowledge of significant and non-significant loci as well as non-genetic factors influencing trait variation
		Performance predictions and validations	Statistical Genetics and Crop Breeding Teams	

Table 4: Objective 4 Deliverables for Year 2

Objective	Sub-Objective	What	To Whom	Impact
4 Increase Routine Use of DNA Information	4a. DNA test and fingerprinting set development and germplasm screening services	New DNA tests for new trait loci of disease resistances and fruit quality components – developed, adapted, converted, refined, or confirmed: • Apple: scab res LG1 Honeycrisp source SSR developed; SCAR adapted for S-genotyping and Type 2 pink flesh; Taqman or HRM SNP-based assays developed by converting SSR/SCAR tests: fruit texture LG10, ethylene/storability LG10 & LG15 crispness LG16 • Sweet cherry: fruit cracking SSR developed • Peach: skin blush SSR developed; fruit type (peach/nectarine) confirmed	Crop Breeding Teams and commercial service providers for DNA-based diagnostics	Demonstration breeders have access to DNA-based diagnostics services and specific tools; lessons learned for commercial providers
		DNA-based diagnostic services for Obj. 1 and 2 – provided to breeders	Crop Breeding Teams	
	4b. Software support	<i>Cross Assist and Seedling Select</i>: Software-based advances relied on other projects due to budget cuts <i>DNA Test Effects</i>: Mixed-model method in ASReml-R to calculate effects of DNA tests, genetic background, and environmental main effects (e.g., year, location) – developed <i>Family Planning</i>: Prototype in Excel to calculate and visualize predicted DNA test effects for up to five traits simultaneously – developed	Crop Breeding and DNA-Informed Breeding Teams DNA-Informed Breeding Team WSU apple breeding program and DNA-Informed Breeding Team	Individual and integrated software tools will help breeders make more informed decisions on parent and seedling selection; software will be useful tools for MAB technical training
	4c. Economics of DNA information use	Templates to calculate breeding costs/benefits for wide range of DNA information applications, via case studies on apple (UMN) and sweet cherry (WSU) – final development stages Calculations of economics of DNA use where benefit modeled is decrease in seedling number in field per cultivar release, via sweet cherry case study (WSU) – poster presentation, ongoing development Case studies of new adoption of DNA information use – analysis in progress (MSU peach), initiated (WSU strawberry)	U.S. Rosaceae 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

Table 4: Objective 4 Deliverables for Year 2 cont.

Objective	Sub-Objective	What	To Whom	Impact
4 Increase Routine Use of DNA Information	4d. Technical training in routine use of DNA information in breeding	Two face-to-face breeder visits – conducted: • Stone fruit: 5-8 Jul, visited 10 companies/ institutions in Calif. • Berry fruit: 13-15 Sep, visited 3 companies in Calif. and 1 on phone	U.S. Rosaceae breeders	Rosaceae crop breeders benefit from use of DNA information to achieve greater efficiency, accuracy, and superior cultivar releases; knowledge of successes and limitations in DNA-informed breeding adoption identifies strategies and weaknesses to focus future efforts
		Compiled information on available DNA tests and information revealed – delivered in-person and online: • DNA tests cards and brochures updated for peach and several new for strawberry, handed out during in-person visits; one new for cherry; apple in development (lowest priority); also provided online; Community Breeders' Page article Mar 2016, ASHS talk • Functional genotype lists: compiled and provided online; CB Page article Jun 2016	U.S. Rosaceae breeders and allied scientists	
		Two half-day workshop technical trainings, at Plant Sciences, Inc. and Pacific Berry Breeders during berry breeder visits, topics: DNA-informed breeding basics, leveraging information from GDR, and integrating DNA tests into breeding operations (and genomic selection for PSI) – conducted		
		Online training resources – provided: • For Breeders webpage revised • Quick Start Guide developed and available • DNA test card and functional genotype list information provided • Various other content provided (e.g., CB Page article archive, FruitBreedomics resources links)	DNA-Informed Breeding and Extension Teams	
		Assessment instrument to thoroughly assess breeding program opportunities, attitudes, status, challenges, and next steps in using DNA information – developed, CB Page article (Dec 2016)	U.S. Rosaceae breeders and allied scientists and DNA-Informed Breeding	
		Annual update by External Evaluator on adoption of DNA-informed breeding by U.S. rosaceous crop breeders including pitfalls and limitations – provided	Administration, DNA-Informed Breeding, and Extension Teams	

Table 4: Objective 4 Year 2 Challenges

Objective	Challenge	Plan for Tackling
4 Increase Routine Use of DNA Information	4a. Range of marker types and platforms desired by the community of screening service providers make it difficult to keep up with all the DNA test conversions	Collaborate with allied scientists (research labs and commercial service providers) to convert to marker types and platforms of interest to them
	4a. Developing each DNA test is not trivial – requires crop expert. Apple, peach, and cherry Crop Postdocs have been too busy curating upstream “RosBREED 1” datasets	Engage students and other postdocs to develop DNA tests (successful examples: Sujeet Verma at UF for strawberry, Feixiong Luo at WSU for apple); Be patient; RB1 datasets almost complete so Crop Postdocs can soon shift to translational genetics
	4b. Budget cuts to software development jeopardize progress. Previous software prototypes (<i>Cross Assist</i> , <i>Seedling Select</i>) getting a bad name because seen as an end-point, not being advanced as intended	Engage interested other projects/experts to advance software and/or prepare new proposal(s)
	4c. Cost:benefit analyses of case studies might not apply to other programs	Templates are being developed that are as generic as possible, and will be provided for breeders to calculate costs and benefits for their own program and provide feedback
	4d. Engaging all breeding programs. In-person visits most preferred according to breeder surveys but >80 U.S. programs. Workshops attached to other events will be attended by only some breeders but do include allied scientists. Require more experts who can assess needs and opportunities of breeding programs.	Attention focused on one-on-one engagement; increase frequency of in-person visits; phone conversation with each interested breeding program at least once in 2017; provide general and crop-specific resources online (for Breeders webpage). Assessment Instrument developed to enable numerous members of DNA-Informed Breeding Team to assess needs and opportunities of each breeding program – put into use by Crop Postdocs and other Team members. CB Page article to announce this combined shifted approach. Presentations at scientific conferences target allied scientists

Table 4 cont.: Objective 4 Year 3 Planned Deliverables

Objective	Sub-Objective	What	To Whom	Impact
4 Increase Routine Use of DNA Information	4a. DNA test and fingerprinting set development and germplasm screening services	New DNA tests from discoveries in Obj. 1 and 2 – developed	DNA Testing Team	Demonstration breeders have sustained access to DNA-based diagnostics services, specific tools, and information on their germplasm
		Use of new haplotype framework to refine DNA tests and convert SNP array information for parents/elites into performance-relevant information – initiated	Crop Breeding Teams	
		DNA testing services provided and transitioning to fee-based – initiated	Crop Breeding and DNA Testing Teams	
	4b. Software support	Data to support DNA information use added to software – ongoing	Crop Breeding and DNA-Informed Breeding Teams	Software will serve breeders in making more informed decisions on parent and seedling selection; software will be useful tool for MAB technical training
	4c. Economics of DNA information use	Cost:benefit case studies (UMN apple, WSU cherry) – analyses completed and communicated	U.S. Rosaceae 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
		New adoption case studies (MSU peach, WSU strawberry) – analyses completed and communicated		
	4d. Technical training in routine use of DNA information in breeding	Content for breeder visits adjusted using Year 2 feedback – ongoing, delivered	U.S. Rosaceae breeders	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
		Breeder personal engagement: face-to-face visits and phone conversations – conducted		
		Online resources: training modules in specific topics – some developed and completed		
		Successful adoption of DNA-informed breeding by U.S. rosaceous crop breeders – quantified; Pitfalls and limitations – identified	Administration, DNA-Informed Breeding, and Extension Teams	

Table 5: Objective 5 Deliverables for Year 2 (green) and Challenges (blue)

Objective	Sub-Objective	What	To Whom	Impact
5 Utilize Stakeholder Input	5a. Cultivar adoption case studies	Producer surveys for case studies of cultivar release – completed and analyses underway (peach: n=33 respondents, 11%), in progress (strawberry)	U.S. peach and strawberry breeders	Insight into decision-making received from peach and strawberry industry members about new elite selections will inform cultivar development and release strategies
	5b. Stakeholder engagement	Year 2 Advisory Panel meeting (Jan 2016): communication of project activities, outcomes, impacts, challenges, receipt, and addressing of feedback – conducted	Advisory Panel members, Project participants, RB Exec Committee	RosBREED project increases effectiveness; external and internal stakeholders value project outcomes
		Update website and distribute Newsletter - accomplished	All	
		Project outcomes and impacts communicated through electronic media and presentations at industry meetings – conducted (numerous channels & venues)	Industry stakeholders	Awareness of and support for RosBREED enhanced; DNA-informed breeding widely accepted by industry stakeholders;
		Jargon-free one-pagers of success stories using breeding program-specific language and consistent format – developed and delivered	Crop Breeding Teams	Extension AP members Dave Eddy and David Karp continue regular contributions to Newsletters and their wider circles of influence; robust data sets of stakeholder and breeder attitudes about DNA information used to adjust project activities
		Breeder engagement in Year 2 with stakeholders about DNA-informed breeding and stakeholder input – obtained and summarized	RB Executive Committee, External Evaluator, Team Leaders	
		Transition to new Extension Team Leader –accomplished	All	

Objective	Challenge	Plan for Tackling
5 Utilize Stakeholder Input	5a & 5b. Outreach and engagement support need has increased; Mercy Olmstead left UF/academia for CA Strawberry Commission – no longer Extension Team Leader	Jim McFerson assumes role of Extension Team Leader, Chrys Ostrander contracted for website support. Establish and complete shared schedules for key activities: Project Director support, Exec Committee support, Team support, Stakeholder Outreach and Engagement.
	5b. Industry stakeholder participation in communication and engagement opportunities remains low	Expand Newsletter distribution (currently 230 recipients). More effort will be placed on industry and project participant outreach. Social media posts appear to have little impact – reconsider effort & focus on Twitter? Publish newsletter on 3/yr basis (was 4/yr) to align with project milestone timing. Work with External Evaluator to improve tracking system for industry audience presentations.
	5b. Need for consistent content with success stories about demonstration breeder use of DNA-informed breeding	Success stories created but mostly confined to Newsletter publication with some push efforts. RosBRIEFs still require prioritization, editing, and formatting for clear, outcome-oriented communication pieces. Work more regularly with External Evaluator.

Table 5 cont.: Objective 5 Year 3 Planned Deliverables

Objective	Sub-Objective	What	To Whom	Impact
5 Utilize Stakeholder Input	5a. Cultivar adoption case studies	Case studies of strawberry and peach cultivar release – analyses completed and results reported	U.S. peach and strawberry breeders	Insight into decision-making received from peach and strawberry industry members about new elite selections will inform cultivar development and release strategies; methodological approach and results provide insights for other breeding programs and crops.
	5b. Stakeholder engagement	Year 3 Advisory Panel meeting (Jan 2017): communication of project activities, outcomes, impacts, challenges, receipt and addressing of feedback – conducted	Advisory Panel members, Project participants, RB Exec Committee	RosBREED project increases effectiveness; external and internal stakeholders value project outcomes; awareness of and support for RosBREED enhanced; DNA-informed breeding widely accepted by industry stakeholders; robust data sets of stakeholder and breeder attitudes about DNA information used to adjust project activities
		Project outcomes and impacts communicated through electronic media and presentations at industry meetings – conducted	Industry stakeholders	
		Additional jargon-free one-pagers of success stories using breeding program-specific language and consistent format – developed and delivered	Crop Breeding Teams	
		Breeder engagement in Year 3 with stakeholders about DNA-informed breeding and their stakeholder input – obtained and summarized	External Evaluator, RosBREED Executive Committee, Team Leaders	

RosBREED Demonstration Breeders Annual Reports for Year 2 (9/1/2015 – 8/31/2016) Progress in DNA-Informed Breeding Summarized by Michael Coe, Cedar Lake Research Group LLC

Respondents: 16 breeders or breeder teams representing 20 rosaceous crop breeding programs
(see page 11)

Breeder-Industry stakeholder engagement about DNA-informed breeding in Year 2

Status

- Eighteen of 20 RosBREED breeding programs engaged their regional stakeholders in formal or informal communications about DNA-informed breeding practices or opportunities. Formal presentations or publications for growers and other industry stakeholders were reported by 15 of the programs. Eighteen of the 20 programs reported informal discussions with stakeholder groups or individuals, focused on DNA-informed breeding opportunities.
- Stakeholders have expressed interest, questions, and positive attitudes toward DNA-informed selective breeding and the RosBREED project, along with concerns about cost, applicability, time to application, and misconceptions about the relationship of DNA-informed selective breeding to genetic engineering. The project has obtained input from stakeholders, but so far general requests for further information and communication have been received, rather than specific requests or recommendations.

Themes in Breeders' Recommendations [number of responses]

- Printed handouts, such as RosBRIEFs and DNA test cards, were seen as useful; particularly those focusing on specific disease resistance or tolerance factors or on applications for specific crops. [5]
- Slides and graphics for use in presentations would be helpful, on various issues including an overview of how DNA information can be applied in breeding programs. [4]
- Continued direct engagement with industry and breeders, including visits to breeding programs and outreach to specific stakeholder groups, is important. [4]



Addressing Breeders' Needs



RosBREED Breeders' Annual Report for Year 2 Cont.

Breeding program use of DNA information

Status

- Nineteen of the 20 programs reported use of DNA information in the past year; one is preparing to do so.
- Eleven programs reported using DNA information for verifying or understanding germplasm identity, relatedness, or parentage; one other program reported being in the process of implementing this.
- Thirteen programs reported using DNA information for parent selection or planning crosses; two others reported being in the process of implementing this.
- Seven programs reported using DNA information for seedling selection or culling; one other program reported being in the process of implementing this.

Breeders' Recommendations [number of responses]

- Training and documentation/tutorials for use of FlexQTL and other software tools [6]
- Continued development of DNA tests for trait loci of near-term value to specific breeding programs and crop groups [6]

Action items developed based on Demonstration Breeders' reports

- Develop complementary slides, brochures, handouts, and online materials that can be used separately or together, using similar style and content so as to reinforce each other and the RosBREED "brand".
- Identify and publicize crop-specific success stories about DNA-informed applications in the context of overall breeding program activities; do not oversell.
- Identify and publicize non-crop-specific RosBREED 2 success stories, such as success stories about students and technical staff members from RosBREED 1 – where they are now, how they were affected by RosBREED experiences, and success stories about scientific accomplishments due to synergistic RosBREED 2 – led activities.
- Continue outreach through the website, newsletter, events, conferences, interactions with stakeholders, etc.
- Respond to Demonstration Breeder recommendations and needs.

Discussion Questions for Break-out Session

Instructions: While in your crop group, please discuss the five questions below and summarize your answers for the reporting session (3:15 pm).

Genomics Research and Use of DNA Information by Breeding Programs

1. What are the key emerging opportunities for DNA-informed breeding that are arising from worldwide Rosaceae genomics research? Is RosBREED best utilizing the outcomes, expertise, and datasets of this worldwide research? How can we better synergize?
2. How can DNA information be effectively integrated into what are mostly traditional breeding programs within the timeframe of RosBREED 2?

Breeding-Industry Interface

3. What's new (or gaining in importance) in industry that breeders need to know about and that RosBREED can help address?
4. At this point, is RosBREED providing a satisfactory return on investment by USDA and industry stakeholders? If not, how do you suggest we adjust activities?

Project Outreach

5. Given that the primary extension audiences are U.S. Rosaceae breeding and industry stakeholders, how effectively are we using avenues to achieve the goals described in the other four discussion questions? How can these avenues be more effectively employed?
 - RosBREED website
 - Newsletter periodical
 - RosBRIEFs
 - Social media
 - Annual RosBREED Advisory Panel meetings
 - Professional meetings (Amer Soc Hort Sci, Natl Assoc Plant Breeders, Rosaceae Genomics Conf)
 - Commodity group meetings
 - Individual breeding program interactions with their industries and other breeders (page 30-31)
 - Others?