## *Dedicated to the genetic improvement of U.S. rosaceous crops*

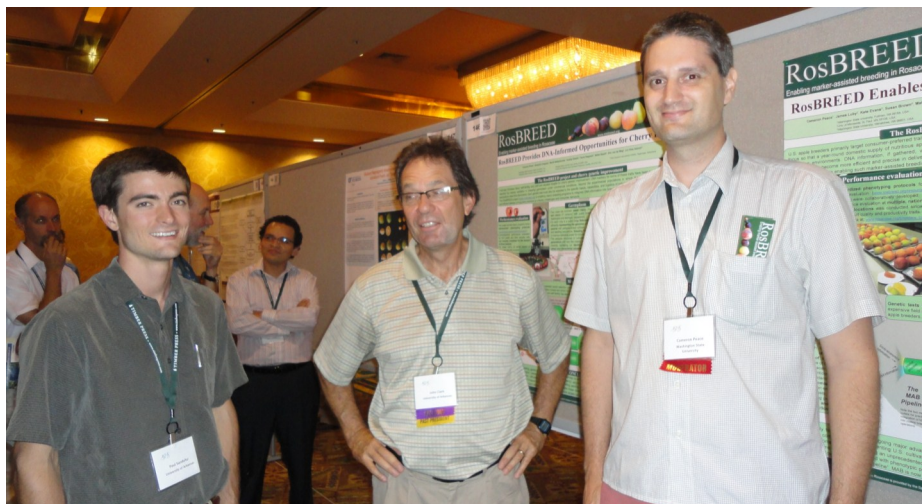**November 7, 2011**        **Volume 2 Issue 4**

### RosBREED at the American Society for Horticultural Science, Hawaii, 2011

Once again, RosBREED participated in the Annual Conference of the American Society for Horticultural Science (ASHS) held from September 25-28, 2011 at the Hilton Waikoloa Village in Hawaii. RosBREED was represented at this meeting with three oral presentations and four poster presentations that described the efforts undertaken by the project in enabling marker-assisted breeding applications in the genetic improvement of apple, peach and cherry. To view the slides of the oral presentations and the posters, please visit: www.rosbreed.org/resources/presentations.

Apart from the hard work, RosBREED Co-PDs present at ASHS 2011 also had an opportunity to meet and network after the sessions.



Paul Sandefur (Univ. of Arkansas), John Clark (Univ. of Arkansas), and Cameron Peace (Wash. State Univ.)

Photo right, starting from left front and going around the table: Richard Veilleux (Virginia Tech), Ita Peace (Washington), Cameron Peace (Wash. State Univ.), Jasper Rees (ARC South Africa), Jeff Olsen (Oregon State Univ.), Anne Plotto (USDA-ARS, FL), Gayle Volk (USDA-ARS, CO), Nahla Bassil (USDA-ARS, OR), Gennaro Fazio (USDA, NY), and Ksenija Gasic (Clemson Univ.)



### Inside this Issue

NIFA

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

# RosBREED by the numbers

## 14

Number of Grower Meetings RosBREED will be attending this winter to showcase phenotypic traits our Demonstration Breeders are evaluating and to receive valuable input form growers regarding <u>their</u> trait priorities. For more information, see page 3.



On November 2, in a Michigan State University research orchard, Amy Iezzoni (Michigan State Univ.), Greg Reighard (Clemson Univ.), and Mike Parker (North Carolina State Univ.) discussed the peach and apple traits that will be prioritized by growers this winter at the Grower Meetings (see page 4)!

## 4

Number of posters RosBREED participants showcased at the September ASHS conference in Hawaii.
Click here to view these posters.
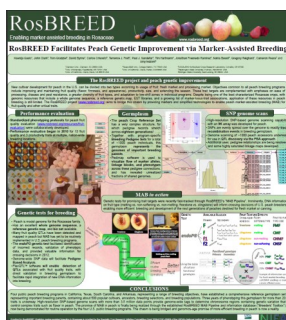




Cameron Peace (Wash. State Univ.), Ksenija Gasic (Clemson Univ.), Nahla Bassil (USDA-ARS, OR), and Jasper Rees (ARC South Africa)

## 7,761,232

Number of SNP markers generated by the Michigan State University iSCAN facility for 953 peach cultivars, ancestors and representative seedlings.



Wow, this is a lot of SNPs!
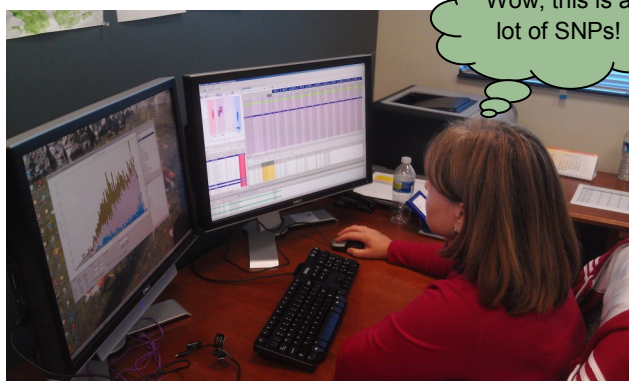
Ksenija Gasic (Clemson Univ) analyzing peach SNP data

# Tell us what you want: Quantifying your priorities for new cultivars

By: Jim McFerson

What is it that growers want to see in a new cultivar? Do strawberry growers in Florida look for the same attributes as those in California or Oregon? What about peach producers in South Carolina, Arkansas, Texas, or California? Apple growers in New York, Minnesota, or Washington? Cherry producers in Michigan and Washington?

Selecting the right cultivar when establishing or renovating a planting is the single most important decision any grower will make. Choosing one from among a portfolio of established cultivars whose characteristics are well known versus a new cultivar that is less well characterized is a fundamental challenge and can create opportunities for both economic success and complete failure.

Is there any possibility we could systematically identify what attributes growers feel are the most important to enhance their profitability and the least important when they select a new cultivar to plant? When growers make that decision, are they thinking about niche markets, production costs, potential yields, pest and disease resistance, or fruit phytonutrient content? Can plant breeding programs actually succeed in producing the cultivars growers prefer? Will consumers and processors be excited enough about a new cultivar to motivate their purchase? Finally, and most importantly, will the grower receive a return on his/her significant investment in a new planting?
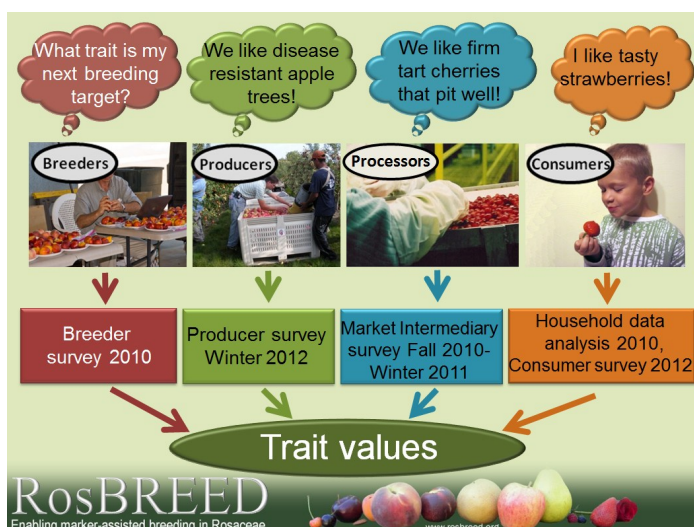
RosBREED's Socio-Economics Team is determined to begin answering these questions and provide plant breeding programs a more specific set of priorities to make their programs more efficient and effective. Currently, breeding targets are based largely upon the breeder's viewpoint, informed by input from the entire supply chain, from grower to processor or packer/shipper to retailer to consumer, but this process is neither transparent nor systematic.

The team has already polled plant breeders themselves and marketing intermediaries about their values and preferences for new cultivars and is now set to survey growers. This is a difficult challenge, given the diversity of apple, cherry, peach, and strawberry growers. They differ significantly for so many factors: location, fresh versus processed use, scale of operation, crop mix, marketing scheme, access to capital, access to labor, potential return of investment on a new planting, etc.

Nonetheless, the team will attack the challenge this winter in an unprecedented effort focused on interactive sessions at regional grower meetings in the most important production areas for apple, cherry, peach and strawberry. A formal national mail-in survey will complement these informal regional sessions and begin in January 2012.

The interactive sessions will include a show-and-tell from the plant breeder working in that geographic area, who will outline the program and its collaborative activities with RosBREED, highlight the traits currently emphasized, and share some of the innovative traits that might be considered for inclusion in a new cultivar. A feature of these sessions will be the use of Turningpoint® technologies. Not unlike a game show, audience participants will be able to answer survey questions flashed on a screen by hitting buttons on remote control clickers right from their seats. The results will be viewed immediately on the screen and the instant feedback recorded for further analysis and comparison to survey information obtained from other components of the supply chain.





## The Power of Diagnostic DNA Tests

Moves selection from the orchard... ...to the greenhouse

Only seedlings predicted to be elite are planted in the orchard for further evaluation

David Bedford, University of Minnesota apple breeder

RosBREED exploits modern genetic tools to improve the efficiency and effectiveness of plant breeding programs. Its Socio-Economics Team will be using modern technology to efficiently gather robust information from stakeholders, so get your clicker fingers ready for a winter meeting coming to a town near you.

# Tell us what you want: Quantifying your priorities for new cultivars

## Clicker survey dates and locations for upcoming Grower Meetings:

| Date of Meeting | Location | Conference | Crop | Demonstration Breeder | SE Member / representative conducting survey |
|---|---|---|---|---|---|
| Dec 6, 2011 | Wenatchee, WA | Wash. State. Hort. Assoc. Annual Meeting | Sweet Cherry | Nnadozie Oraguzie WA State Univ. | Vicki McCraken (WA State Univ) & Jim McFerson (WTFRC) |
| Dec 6, 2011 | Wenatchee, WA | Wash. State. Hort. Assoc. Annual Meeting | Apple | Kate Evans WA State Univ. | Vicki McCraken (WA State Univ) & Jim McFerson (WTFRC) |
| Dec 6, 2011 | Grand Rapids, MI | Great Lakes Expo | Strawberry | Jim Hancock MI State Univ. | Audrey Sebolt MI State Univ. |
| Dec 6, 2011 | Grand Rapids, MI | Great Lakes Expo | Apple | Dave Bedford Univ. of MN | Audrey Sebolt MI State Univ. |
| Dec 7, 2011 | Grand Rapids, MI | Great Lakes Expo | Tart Cherry | Amy Iezzoni MI State Univ. | Audrey Sebolt MI State Univ. |
| Dec 13, 2011 | Watsonville, CA | Fumigation Safety Symposium of the California Strawberry Commission | Strawberry | To be determined | Alicia Rihn, Univ. of MN |
| Jan 6, 2012 | Savannah, GA | SE Regional Fruit and Veg Conf | Peach | Ksenija Gasic Clemson Univ. | Greg Reighard (Clemson Univ.) & Cholani Weebadde (MI State Univ.) |
| Jan 10-11, 2012 | Ashville, NC | SE Apple Growers Meeting | Apple | Jim Luby Univ. of MN | Alicia Rihn, Univ. of MN |
| Jan 11, 2012 | Minnesota | Minn Apple Growers | Apple | Dave Bedford Univ. of MN | Chengyan Yue Univ. of MN |
| Jan 24-26, 2012 | Syracuse, NY | Empire State Fruit and Veg Expo | Apple | Susan Brown Cornell Univ. | Karina Gallardo WA State Univ. |
| Feb 2, 2012 | Hershey, PA | Mid-Atlantic Fruit and Vegetable meeting which covers all of the Rosaceae crops + National Peach Council Annual Meeting | Peach | John Clark Univ. of AR | Greg Reighard Clemson Univ. |
| Mid-Feb, 2012 | CA | CA Stone Fruit meeting | Peach | Tom Gradziel UC Davis | To be determined |
| Feb 28, 2012 | North Willamette Research & Extension Center, OR | Annual grower meeting for Strawberry growers | Strawberry | Chad Finn USDA-ARS | To be determined |
| Aug 17-18, 2012 | Plant City, FL | Florida Strawberry Growers Association Annual Educational Seminar | Strawberry | Vance Whitaker Univ. of FL | Cholani Weebadde MI State Univ. |

# Breeder profile: Nnadozie Oraguzie
By Audrey M. Sebolt, Project Assistant



Nnadozie Oraguzie, Washington State University



Figure 1: Range of skin colors from yellow to dark red that are sought after by the Washington State University sweet cherry breeding program



Figure 2: Nnandozie's research technician, Blessing Athanson, measures titratable acidity.

If you have ever eaten the sweet cherry 'Rainier', a fruit whose delicate flavor sings with sweetness and whose cheeks have been kissed red by the sun, then you have eaten a cultivar that was developed and released in 1952 by Washington State University's breeder Dr. Harold Fogle. 'Rainier' has the highest valued fruit of any sweet cherry cultivar produced in the Pacific Northwest (PNW).

*In the years following…* Sweet cherry progeny, generated by Dr. Tom Toyama (Dr. Fogle's successor) were released as new cultivars by a series of researchers, primarily to help spread the harvest window.

*Fast forward many years..*. With support from the PNW sweet cherry industry, the Washington State University sweet cherry breeding program was revived in 2004. Start-up funding was provided by the Washington Tree Fruit Research Commission and Oregon Sweet Cherry Commission. Dr. Amy Iezzoni, Michigan State University's tart cherry breeder, was hired as a consultant for the program because of her extensive knowledge of cherry genetics and collection of European cherry germplasm (for more information, see RosBREED's "Breeder Profile": Amy Iezzoni). She was asked to initiate crosses leading to new sweet cherry cultivars that would increase the varietal options (Figure 1) for PNW sweet cherry growers.

After initial populations were established, Dr. Nnadozie Oraguzie was hired in 2008 as the full-time breeder for the PNW sweet cherry breeding program. Nnadozie had previously been an apple breeder at HortResearch in New Zealand for 10 years.

*Stage I – generating plant materials.* Nnadozie focused on designing crosses based on the phenotypes of parents and a working knowledge of trait heritabilities. Nnadozie would make about 60 crosses each spring, which would yield 2000-5000 seeds. Once these seedlings produced fruit, three to five years after the initial cross, his program would evaluate these seedlings for several years. Once a promising seedling was found, he would propagate it for advanced trials. Unfortunately, a high proportion of seedlings would be self-infertile and/or produce small fruit; this wasted resources spent on those inferior plants.

Increased fruit size is an economically valuable trait because ±2 mm in diameter can mean the difference between profit and loss for growers; therefore, discovering loci for increased fruit size is critical. If a self-fertile parent, which contains only one self-fertile allele, is crossed to a self-infertile parent, then usually half of the seedlings are self-fertile. Determining which seedlings are self-fertile in the field can take several years. New self-fertile cultivars are valuable to the PNW industry because they would not require a compatible pollinizer nor bees to achieve adequate fruit set. Often pollinizers are considered lost production revenue because they produce inferior fruit or require separate cultural and harvest regimes.

## Breeder profile continued

Box A: Traits that Nnadozie selects for according to type and genetic test availability.

| Current M-L-T | Future M-L-Ts | Additional Traits |
|---|---|---|
| Self-fertility | Late bloom time | Sufficient yielding |
| Fruit flavor: acidity and sugar | Ripening dates – early and late season | Disease resistance: bacterial canker |
| Fruit quality: size and firmness | Freestone | Pedicle retention force – stems remain attached to fruit after mechanical harvesting (or stem-less) |
| | Fruit appearance: skin and flesh color | Skin pitting: skin is not damaged after fruit is harvested, sorted and/or packaged |
| | Low cracking incidence | |
| | Disease resistance: powdery mildew | |
| | Fruit doubling | |
| | Consistent fruit production performance | |

*Stage II – increasing breeding efficiency through adoption of marker-assisted breeding.* Nnadozie's program was one of the first RosBREED Demonstration Breeding programs to adopt the Marker-Assisted Breeding (MAB) Pipeline, developed by Dr. Cameron Peace (Washington State University). In 2008, Nnadozie and Cameron began to fast-track the WSU seedlings for RosBREED's "jewels" (critical sweet cherry traits). These traits already had genetic markers associated with them and include increased fruit size, firmness (RosBREED's "Jewels in the Genome": Sweet cherry fruit size and firmness) and flavor (acidity and sugar; Figure 1), and self-fertility (RosBREED's "Jewels in the Genome": Cherry self-incompatibility); for information about how to apply this "jewel", see the Community Breeders' Page in this Newsletter. In the last two years, almost 3000 seedlings have been screened by Cameron's Pacific Northwest Tree Fruit Genotyping Lab in Pullman for these genetic tests. More than half of the seedlings have been culled and the remaining seedlings planted, the net future savings (by avoiding land use fees and tree maintenance and evaluation costs) is estimated at more than $75,000.

For RosBREED, Nnadozie has provided a total of 240 seedlings and cultivars for the Sweet Cherry Crop Reference Set and another 240 for his Breeding Pedigree Set, to well represent the genomes of important breeding parents in his program. This germplasm has already been screened for two "jewels" (genetic tests for fruit size and acidity) via the "fast-tracked pipelining" approach and genome-scanned using the International RosBREED SNP Consortium cherry 6K SNP array. The genome scan data will be analyzed with two years of field data for ~15 traits, which is expected to result in the discovery of many new "jewels" for sweet cherry (Box A).

While Nnadozie appreciates the focus of RosBREED on fruit quality traits, as these are of highest priority to his program, he also hopes that before graduation, his PhD student Murali Bellamkonda (see below) will have found markers to identify seedlings that are resistant to powdery mildew and bloom later in the spring. Nnadozie feels that marker-assisted breeding is efficient because of the shining jewels already available and used in his program, and the systematic Pipeline that Cameron has developed for polishing new jewels. Nnadozie is also excited to utilize the Breeder's Toolbox that RosBREED developed; next spring he hopes to use the Toolbox for cross planning!

### Meet Nnadozie's Breeding Trainee: Murali Bellamkonda



Murali Bellamkonda, Washington State University

**Why did you choose Nnadozie Oraguzie's program?** I joined Dr. Nnadozie Oraguzie's sweet cherry breeding program because Washington State University is a world-class institution when it comes to plant sciences and Nnadozie is an experienced fruit breeder with multinational exposure and expertise. I am very much grateful to him for introducing me into this beautiful world of Rosaceae fruit breeding and associating me with this gigantic RosBREED project.

**What is your thesis project?** For my thesis project, I am working on the genetic control of bloom time, harvest date, fruit firmness and powdery mildew disease resistance.

**What benefits have you seen by being part of RosBREED?** There are many advantages to being a part of RosBREED: first of all, I have been participating and getting training in all aspects of the breeding program. RosBREED gave me the opportunity of understanding all phases of marker-assisted breeding techniques in sweet cherry. I have also gained experience in Pedigree-Based Analysis through annual RosBREED Workshops and would like to have the same experience for high-throughput SNP marker data analysis. Finally, I get the opportunity of meeting with several people with expertise in different disciplines and from different institutions across the USA.

# Community Breeders' Page

**A success story in Rosaceae marker-assisted breeding: larger fruit for sweet cherry. What can we learn?**

By Cameron Peace, MAB Pipeline Team Leader

Quantitative trait loci – they're a dime a dozen, right? For the last decade every DNA lab has been churning out QTLs, and along with each is the promise of great utility in breeding. Yet the cherry fruit size QTL on *Prunus* chromosome 2, May 2010's "Jewel in the Genome", <u>is</u> actually influencing decisions about crossing, seedling selection, and elite selection advancement. So what makes this QTL different, and how soon can we polish up more jewels like this??
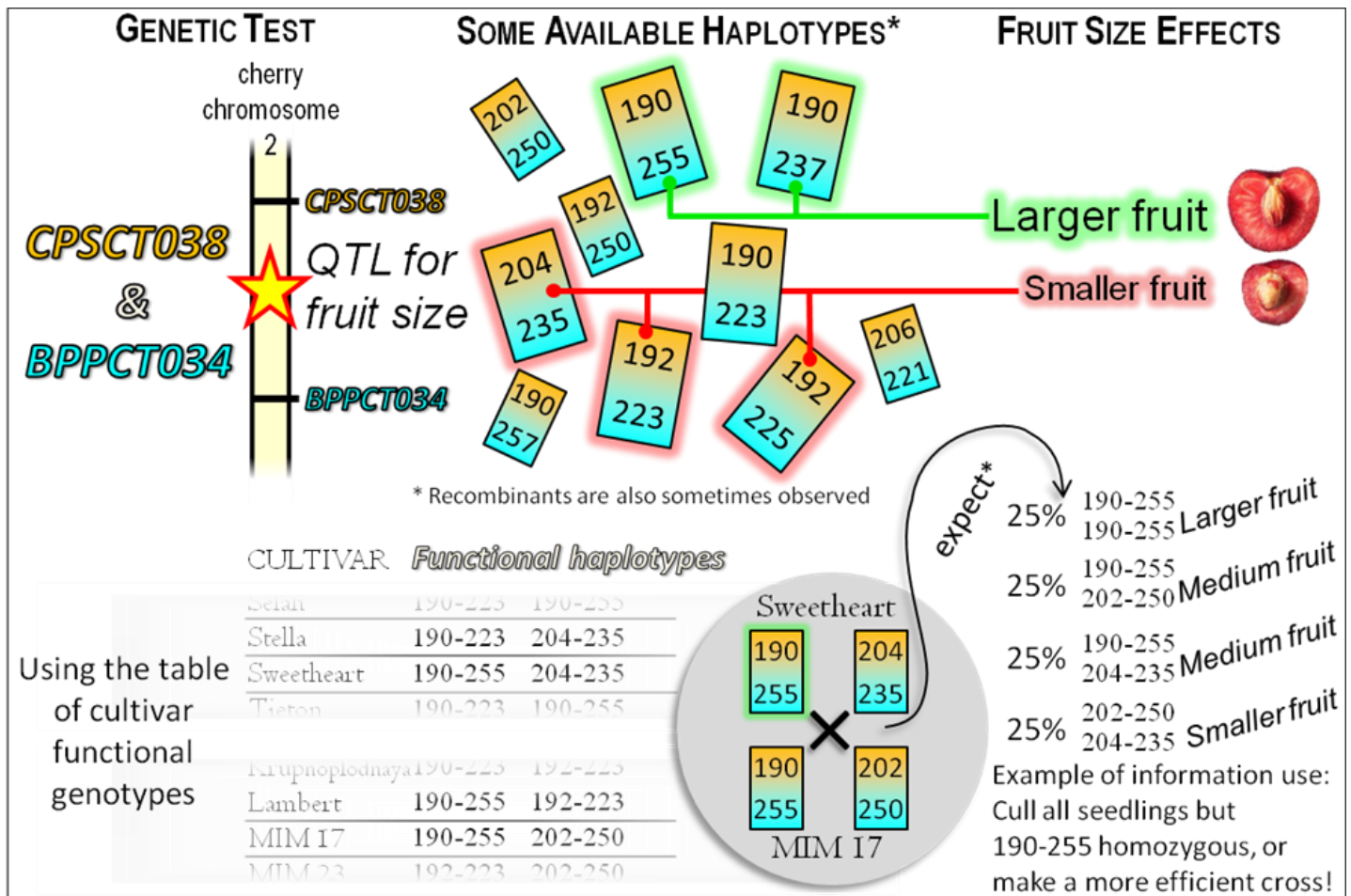
# Advisory Panel Member Profile Page

The success of RosBREED will be determined in large part by the people behind it. Because of this, we wanted to give you some insight into these individuals — whether they represent university extension, the scientific community, or industry — who are at the core of our efforts. Panel members were asked about their background and what they want to accomplish as part of the RosBREED project. Here is what they had to say.

# Extension



**CLARK SEAVERT**
Professor, Oregon State University, Department of Agricultural and Resource Economics, clark.seavert@oregonstate.edu

What work do you do? Research, teaching and Extension/Outreach with an emphasis on economics, risk management and decision tools for ornamental, nursery, and berry crops.

Why are you interested in RosBREED? Because I believe one of the greatest impacts agricultural research can provide in the future of crop production are new varieties with consistent yield, quality, size, and consumer acceptance.

How do you feel you can contribute to RosBREED? With my experience I can provide a broader perspective with an economist viewpoint, in particular cost-benefit analyzes.

# Industry



**PHIL KORSON**
President, Cherry Marketing Institute Inc., Executive Director, Michigan Cherry Committee, Executive Director, Michigan Association of Cherry Producers, pkorson@aol.com

What work do you do? The Cherry Marketing Institute is the National Promotion and Research Organization for the Tart Cherry Industry. It is supported by both growers and handlers and is all about growing and expanding our markets and products. The health benefits of cherries and their superfruit status has been a way for us to recreate our industry. Profitability at all levels of our industry has been our priority.

Why are you interested in RosBREED? I am interested in RosBREED because it brings to the table in a very collaborative way scientists from all over the world with a focus on improving fruit quality. This is key to our future! Some of our major challenges need to be addressed through breeding. I am excited to be a part of this project and view it as a way to optimize our breeding programs.

How do you feel you can contribute to RosBREED? I manage all of the Industry's production research programs and with that comes lots of grower input nationally. This allows me to share with RosBREED the things that are important to our farmers. We solve real problems when we can work together for the greater good of all cherry farmers.

# Scientific



**LAILIANG CHENG**
Associate Professor in Physiology of Fruit Crops, Department of Horticulture, Cornell University, LC89@Cornell.edu

What work do you do? My research is largely focused on nitrogen and carbon metabolism in apple, which contributes to our knowledge of how to grow fruits with better quality. I am currently using a metabolite profiling approach in combination with assay of the transcript level and activity of the key enzymes involved in primary metabolism to understand how the nitrogen and carbon metabolism in apple fruit responds to alterations in nitrogen supply, carbon supply, and genetic manipulation of sorbitol/sucrose synthesis. I am also very interested in why pome and stone fruits of the Rosaceae family synthesize and utilize sorbitol and its role in sugar/acid accumulation, stress tolerance, and mineral nutrition.

Why are you interested in RosBREED? I am very interested in RosBREED because it provides an excellent opportunity for me to interact with many geneticists and breeders to gain a better understanding of the biology and management of Rosaceae fruit crops. Furthermore, the outcome of RosBREED directly benefits my research.

How do you feel you can contribute to RosBREED? While a plant's genetic make-up determines its metabolic potential, collaborations between geneticists/breeders and physiologists will lead to synergistic inter-disciplinary approaches to understanding the genetic control of plant metabolism, and its interaction with the environment (nutrient supply, water, sunlight, etc) to achieve the ultimate goal of superior fruit quality.

# Jewels in the Genome
By Amy Iezzoni, Project Director

*What is a "Jewel in the Genome?"*
- *An individual's genome is the full complement of genetic information that it inherited from its parents. Within this vast repertoire of genetic information, individual genes are being discovered that control critical production and fruit quality traits. As these valuable rosaceous gene discoveries are made and put into breeding applications, we will describe them in this column as "Jewels in the Genome."*

**Peach flavor** is influenced by a delicate balance of sugar, acid content, and aromatic volatiles. Developing flavorful peaches is a high priority for breeding programs; however, obtaining the optimum combination of these desirable taste attributes has been challenging as their genetic control is complex. A series of studies have identified a region on peach chromosome 4 that contains genes with genetic variation for sugar and acid levels in peach breeding germplasm. In particular, this region was identified in multiple populations over multiple years based on evaluations of three sugars (fructose, glucose and sorbitol) and three acids (malic, citric and quinic) (Quilot et al. 2004; Dirlewanger et al. 2006).

With genetic knowledge of the functional variants for this chromosome 4 trait locus in their plant material, breeders can begin to predict the fruit taste attributes of their breeding materials resulting in more efficient crosses. Therefore, because knowledge of this chromosome 4 peach flavor region will lead to more efficient breeding of peaches with desirable eating quality, it is chosen as our eighth featured "Jewel in the Genome."

Dirlewanger E, Cosson P, Renaud C, and Monet R. 2006. New detection of QTLs controlling major fruit quality components in peach. Acta Hort 713: 65-72.

Quilot B, Wu BH, Kervella J, Genard M, Foulongne M and Moreau K. 2004. QTL analysis of quality traits in an advanced backcross between *Prunus persica* cultivars and the wild relative species *P. davidiana*. Theor Appl Genet 109: 884-897.



Figure 1. South Carolina grower Sam Hall enjoying a flavorful peach.





Figure 2. Terrence Frett (Clemson University) sampling a peach for percent sugar. This peach measured very high!

# RosBREED: Enabling marker-assisted breeding in Rosaceae

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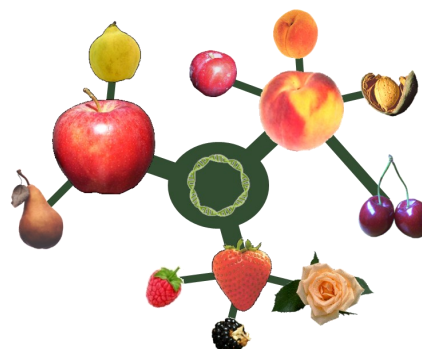
Visit us at
**www.rosbreed.org**

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| Jim McFerson | Industry | Washington Tree Fruit Research Commission |
| Dorrie Main | Genomics | Washington State University |
| Cameron Peace | Marker-assisted breeding pipeline | Washington State University |
| Eric van de Weg | Pedigree-based analysis | Plant Research International, The Netherlands |
| Cholani Weebadde | Extension | Michigan State University |
| Chengyan Yue | Socio-economics | University of Minnesota |

# Calendar of events

- **January 12, 2012: Annual RosBREED Advisory Panel Member meeting. San Diego, CA**

- **March 12-15, 2012: Annual RosBREED Project Planning meeting for project participants. East Lansing, MI**

- **July 30, 2012: Rosaceae Community Breeder Participatory Workshop in conjunction with 2012 ASHS. Miami, FL**