RosBREED

Combining Disease Resistance with Horticultural Quality in New Rosaceous Cultivars

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Advisory Panel Meeting

Jim McFerson, Extension Team Leader, Washington State University

Who would have thought a couple of data-heavy Excel spreadsheet tables in the RosBREED annual report could get our Industry, Scientific, and Extension Advisory Panel members excited? Well, that was exactly what happened at our project meeting in San Diego on 11 January during Project Director Amy Iezzoni's opening presentation.

What really got them excited was the amount of green on those spreadsheets detailing progress towards the use of DNA tests for a range of traits: diseases, physiological disorders, fruit development and quality, and reproductive behavior. Many of the participants from Michigan immediately jumped to the conclusion that the green highlights celebrated official MSU colors, but other less partisan participants correctly observed that each green cell in the table demonstrated the use of crop- and trait-specific tests in rosaceous crop breeding programs. [https://www.rosbreed.org/Annual-Report]

Subsequent presentations by team leaders provided more detail on the steady accumulation of new knowledge and development of new tools across crops and traits, all focused on the RosBREED goal of combining disease resistance with horticultural quality in new rosaceous cultivars, drawing very positive reviews from Advisory Panel members. The summary tables provided a simple snapshot of a fundamental RosBREED outcome. DNA-informed breeding is having an impact,

Fig. 1. RosBREED Advisory Panel hard at work.

improving the efficiency and effectiveness of U.S. rosaceous crop breeding programs.

As usual, Advisory Panel members also shared some concerns. Many noted the accumulation of massive datasets and delays in data analysis and DNA test development could become a burden for project members and slow progress towards making more DNA test cells green. Further, they cautioned, the need for genetic improvement of many other traits not considered in RosBREED 2 should be kept in mind. Attributes like mechanization-ready plant architecture, enriched flower and fruit aromatic profiles, and additional disease resistances led that list.

Gratifyingly, Advisory Panel members also shared their enthusiastic appreciation for the organization and logistical competence of the project leadership and staff, along with its community-oriented approach and general sense of trust among team members. Lailiang Cheng's comment encapsulated the Panel's

Fig. 2. Advisory Panel Members and project participants.

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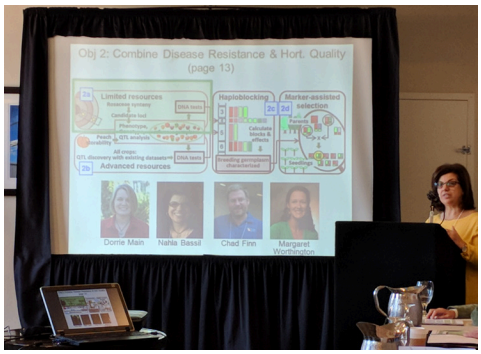

Fig. 3. Nahla Bassil, DNA Testing Team leader, reporting to the Advisory Panel.

Fig. 4. Ksenija Gasic, Stone Fruit Breeding Team leader, plotting next year's Prunus *research activities during breakout session.*

assessment: "RosBREED has served as a model of collaborative projects."

While such positive input is much appreciated, the project leadership also benefits from the Advisory Panel's constructive criticism and incorporated that into the agenda for the participant meeting in East Lansing MI from 6-7 Mar. Our next newsletter will summarize highlights from that meeting.

In the meantime, everyone is motivated by Jim Allen's closing remark: "I am still learning after many years of attending. This is a great use of taxpayer money, but the most impressive thing is all of the green in the DNA test tables – I hope to see more green next year."

International Partners Meeting

RosBREED has been fortunate to benefit from active collaboration with international scientific partners, most of whom also participate in the annual Advisory Panel meeting. On 12 January, 36 participants gathered to share the latest news about discoveries, techniques, and future targets. This all-day, all-science meeting, organized by Nahla Bassil, ensures the Rosaceae community stays in regular communication, working collectively to leverage resources and contribute to research progress.

Fig. 5. International Partners Prunus working group: (front) A. Iezzoni, L. Meisel, K. Gasic, F. Fernandez, J. Piaskowski; (back) S. Venderzande, J. Quero-Garcia, C. Saski, D. Mather, I Pacheco, M. Fouche, P. Arus.

And, in fact, the meeting is not exactly ALL science. Participants also enjoy the opportunity to meet with familiar colleagues and greet new ones, building a network that has consistently grown over the years. The next opportunity for this networking is coming soon, at the Ninth Rosaceae Genomics Conference, Nanjing China, 26-30 June 2018. [www.rgc9.org].

Featured Team Member

Guido Schnabel

Kathleen Rhoades, Extension Team Member, Michigan State University

Guido Schnabel has been a plant pathologist at Clemson University for almost 20 years, working mainly with peaches and strawberries on the problem of pesticide resistance. He became a member of the RosBREED Pathology Team to support RosBREED2's objective of incorporating durable disease resistance into breeding parents, and works mainly with Clemson peach breeder Dr. Ksenija Gasic.

Guido is originally from Germany and became interested in plant pathology specifically from the angle of pesticide science.

"I always wondered about these chemicals that we are releasing in the environment and whether they are really necessary," Guido said, "And the more I learned about them, the more intrigued I became about these new developments, about reduced-

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Fig. 6. Guido Schnabel in his office.

risk fungicides and the possibility to use less without detracting from efficacy."

Guido completed his Ph.D. at the University of Stuttgart in Germany and moved to East Lansing MI, where he studied apple diseases at Michigan State University. He worked with Dr. Alan Jones for about three and a half years before being hired as a plant pathologist at Clemson University.

Guido's first challenges at Clemson were uncontrolled outbreaks of brown rot and anthracnose in orchards among peach growers. In both cases widespread fungicide resistance prevented effective control, which Guido characterized and then came up with alternative spray programs to manage resistance.

"Resistance to fungicides has impacted our industry quite a bit, and we've been able to deal with this and manage it," Guido said.

Since combating brown rot and anthracnose, Guido has been moving down the list of other pathogens and disorders that are severely impacting South Carolina peach and strawberry growers.

"I am moving into investigating skin disorders," he said, "There's a disorder called bronzing that every so often causes some major losses. And it certainly doesn't make customers very happy to see blotches on peach skin."

Guido said he and his team aren't sure what causes bronzing, but they do know it is not a pathogen and suspect it to be a physiological disorder. His team is also looking at another skin disorder called "tiger stripe," in which fruit have streaks running down their sides that look almost like acid damage. Wood-decaying fungal pathogens are another rising cause for concern in South Carolina, so Schnabel's team is taking a look at those as well.

Within RosBREED Guido works with Ksenija Gasic on the development of assays to evaluate peach selections for disease susceptibility and tolerance. Guido has developed an assay for bacterial spot susceptibility and was also involved in developing and fine-tuning an assay for brown rot tolerance. Thanks to these assays and the hard work of the peach breeding team there is now a DNA test in use to screen for bacterial spot resistance and more tests in development for bacterial spot as well as brown rot resistance.

Fig. 7. Guido and Clemson scientist Juan Carlos Melgar in the field.

Guido said that the chemicals currently available for treating bacterial spot are not effective, especially when disease pressure is high. That's why breeders are important to disease management, and where his interests intersect with Gasic's.

"I'm glad that I'm part of RosBREED because I contribute to this whole process, which of course makes me feel good" Guido said. "If we can come up with some selections that are less susceptible to bacterial spot, it will have a huge impact on our industry."

When he is not working on plant pathology, Guido enjoys competitive table tennis and long-distance running.

Jewel in the Genome

Soft Scald and Soggy Breakdown in Apple

Amy Iezzoni, Project Director, Michigan State University

Soft scald and soggy breakdown are major post-harvest physiological disorders of apple that typically develop weeks after harvest when the fruit is in cold storage. Symptoms appear as brown lesions on the fruit surface and internal flesh breakdown, with the fruit becoming soft, spongy, and completely unmarketable (Fig. 8). The widely popular and very profitable cultivar 'Honeycrisp' is highly susceptible to these disorders, making post-harvest handling particularly challenging, along with the production challenges 'Honeycrisp' offers. Research by post-harvest physiologists over the past few years, however, has delivered protocols that can prevent, or least diminish, the chilling injury that predisposes 'Honeycrisp' to these storage disorders. Fruit is initially held at cool temperatures (≅50 °F) for several days prior to putting it in cold storage (≅37 °F). While this protocol reduces losses caused by these disorders in 'Honeycrisp', it is not needed for other cultivars and complicates the logistics of fruit handling for apple growers and packing houses. Based on stakeholder input, developing new apple

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Fig. 8. Soft scald and soggy breakdown in apple. Photo credit: Cindy Tong.

cultivars less susceptible to these disorders is a high priority.

Fortunately, apple germplasm in the U.S. varies greatly in susceptibility to these disorders. A genetic study led by Jim Luby's RosBREED apple team at the University of Minnesota identified a locus on apple chromosome 2 that is associated with the susceptibility (Howard et al., 2018). One of the alleles at this locus, named HDI for High Disorder Incidence, conferred increased susceptibility, with two HDI alleles resulting in the most severe soft scald and soggy breakdown. Parental sources of the HDI allele that have and are being used in apple breeding include: 'Honeycrisp', 'Northern Spy', and 'Rome Beauty', with 'Honeycrisp' being homozygous for the susceptibility allele (*HDI/HDI*).

A DNA test for routine screening for the HDI allele is currently being developed. This DNA test is being used for the first time in 2018 in the University of Minnesota breeding program to select against individuals that have the HDI allele, in particular, those that are homozygous for HDI, as they are predicted to have the highest disorder incidence. Therefore, because knowledge of this chromosome 2 region will lead to the more effective breeding of apple cultivars with reduced susceptibility to soft scald and soggy breakdown, it is featured as a RosBREED "Jewel in the Genome".

Reference

Howard N, van de Weg E, Tillman J, Tong C.B.S, Silverstein K, Luby J. 2018. Two QTL characterized for soft scald and soggy breakdown in apple (Malus ×domestica) through pedigree-based analysis of a large population of interconnected families. Tree Genetics and Genomes 14:2 doi: 10.1007/s11295-017-1216-y.

Where Are the RosBREEDlings Now?

Sujeet Verma (University of Florida)

Where are you now and what are you doing?

Currently, I am working as a geneticist at the Gulf Coast Research and Education Center, University of Florida (UF). I assist Dr. Vance Whitaker, the strawberry breeder at UF, and the strawberry breeding program by conducting genetic analyses of various disease and fruit flavor trials with a focus to identify genetic sources of disease resistance and better fruit flavor. I train graduate students and teach them pedigree-based analysis (PBA) using FlexQTL™. I assist the UF strawberry breeding program in the development of

Fig. 9. Sujeet Verma showing off strawberry selections. Photo credit: Sujeet Verma.

DNA-based markers and conduct marker-assisted seedling and parent selection. I am also involved in genomic selection projects.

How were you involved with RosBREED? Did it prepare you for your current position?

I joined Dr. Cameron Peace's lab in Fall 2009 as a PhD student at Washington State University, Pullman. Interestingly, the RosBREED project started at that time, and you know whoever works for Dr. Peace, almost always also works for RosBREED! I still recall my first PBA workshop at Lansing, MI, in 2010. I was highly influenced by the PBA approach taught by Drs. Eric van de Weg and Marco Bink. I participated as an MAB Team member.

Just looking at my description above, anyone can tell that I am utilizing all the skills that I acquired during my PhD at my new position. So, yes, it did prepare me for my current position.

What was your most memorable experience(s) with RosBREED?

There are several of those! Interactions with fellow graduate students during RosBREED 1 provided the most memorable experiences I can recall. Every time when we met at East Lansing, MSU, for PBA workshops, we shared meals and stories with each other and we helped each other move forward! I still cherish those moments when I meet with RosBREEDlings!

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Any advice for RosBREED's current participants?

The only thing I would recommend is to engage with as many researchers as possible and try to work with different crop groups as much as you can! This is a great scientific community where everybody helps each other move forward.

Paul Sandefur (Fall Creek Farm & Nursery, Oregon)

Where are you now and what are you doing?

I've now been working at Fall Creek Farm & Nursery as U.S. Blueberry Breeder for just over a year. My primary responsibility is the development of superior mid- and high-chill blueberry varieties. I am very fortunate to be part of a global team dedicated to creating a world with better blueberries.

How were you involved with RosBREED? Did it prepare you for your current position?

I was one of the lucky few RosBREEDlings who was able to take part in RosBREED 1 and RosBREED 2. My MS and PhD work involved the development of DNA tests for routine use in peach, cherry, and apple breeding programs, and thanks to RosBREED, I had the opportunity to work closely with many progressive fruit breeders across the U.S. During my six years as a RosBREEDling, I was part of the teams responsible for collecting the phenotypic data that is the backbone of molecular studies, generating genomic data, and utilizing all available data to develop some of the first fruit quality DNA tests available to fruit breeders.

My involvement with RosBREED was a key component of my graduate school experience and prepared me for my current position as blueberry breeder. Although I no longer work with a Rosaceae crop, RosBREED set the foundation for my future work in other fruit crops across ploidy levels.

What was your most memorable experience(s) with RosBREED?

Fig. 10. Paul Sandefur phenotyping the old-fashioned way. Photo credit: Paul Sandefur.

My most memorable experience with RosBREED must be the very first annual meeting I attended, I believe it was the first of such meetings. At the time I had just started my MS degree and knew next to nothing about the project and the aspirations of the participants. I was so astounded by how many researchers, names I knew from fruit breeding and related publications, were gathered to work together toward a common goal. I am proud looking back, now 8 years later, to see just how much has been accomplished.

Any advice for RosBREED's current participants?

The best advice I can give to any RosBREED participant, specifically a current RosBREEDling, is to take full advantage of the great resources available at your fingertips. There is an incredible trove of data and tools available that can turn your research into meaningful results and stimulate years of discovery, but even more importantly, there are dozens of leading scientists from whom you can gain so much, including making lifelong friends and colleagues.

Credit: Fall Creek Farms & Nursery, LLC.

Community Events

9th Rosaceae Genomics Conference
26-30 June 2018
Nanjing Agricultural University
Nanjing, China
www.rgc9.org

ASHS Annual Conference
31 July-3 August 2018
Washington, DC
www.ashs.org/page/GeneralConference

Credit: Fall Creek Farms & Nursery, LLC.

Cultivar Corner

Audrey Sebolt, Michigan State University

'Amoore Sweet'

Inventor: **John Clark, Dept. of Horticulture, University of Arkansas**

Collaborator: **Paul Sandefur (RosBREEDling), blueberry breeder, Fall Creek Farm & Nursery, Lowell, OR**

What year was 'Amoore Sweet' released?

2013

What makes 'Amoore Sweet' special?

It is the first nectarine released from the University of Arkansas breeding program with non-melting flesh and low-acid flavor. It also has good bacterial spot resistance.

When was the cross made?

2001

What is the pedigree?

Arkansas 699 × Arkansas 663. Both of the parents are nectarine selections from the University of Arkansas breeding program. The pollen parent of Arkansas 699 was a Brazilian cultivar named 'Chiripá' with a distinct slow softening texture. Arkansas 663 is a very tasty yellow-fleshed nectarine selection with standard acidity and non-melting flesh.

What is the size of the family from which 'Amoore Sweet' was selected?

There were only 50 seedlings in the family 'Amoore Sweet' was selected from. One other selection from this family was also released in 2013 as 'Bowden'. While 'Amoore Sweet' is yellow-fleshed and has low acid flavor, 'Bowden' is white-fleshed and has standard acidity. So, the Arkansas 699 x Arkansas 663 family was segregating for both flesh color and acidity!

Are there other siblings from this cross that have commercial potential?

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How has this cultivar been used in RosBREED?

'Amoore Sweet' was a parent in one of the populations used for pedigree-based mapping of QTL for bacterial spot resistance, maturity date, flesh color, acidity, sweetness, and other traits during RosBREED 1. It was also used as a parent in the populations being phenotyped for mealiness and bacterial spot resistance in RosBREED 2. We have DNA test data for maturity date, skin color, flesh/stone type, acidity, fuzz, flesh color, and bacterial spot resistance in 'Amoore Sweet'. This information is used routinely for planning crosses in the University of Arkansas peach breeding program. For instance, the *D* locus is responsible for the difference between high- and low- acid peaches, with low acidity dominant to high acidity. We know from DNA tests that the low-acid 'Amoore Sweet' is heterozygous (*D*|*d*). If we want to generate more high-acid yellow-fleshed nectarines, we can cross 'Amoore Sweet' to a high-acid selection and expect half of the progeny to have high acid and the other half low acid.

Any other interesting notes about 'Amoore Sweet'?

'Amoore Sweet' was named in honor of distinguished emeritus professor James N. Moore. The late Dr. Moore founded the fruit breeding program at the University of Arkansas and was a beloved colleague and mentor to many in the RosBREED community.

Why should growers plant 'Amoore Sweet'?

'Amoore Sweet' is a nice complement to high-acid yellow-fleshed peaches for growers in the Eastern U.S., especially those selling to local markets. Having a low-acid cultivar or a nectarine at the farmers' market or roadside stand along with more typical peaches gives consumers more options and will hopefully increase profitability!

Two legendary Arkansas fruit breeders: John Clark and Jim Moore. Photo credit: John Clark.

In the next issue

- **Rosaceae Nemesis & Solution**
- **Progress and updates from our annual participant meeting**
- **Where Are the RosBREEDlings Now?**
- **Meet some more AP Members**

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