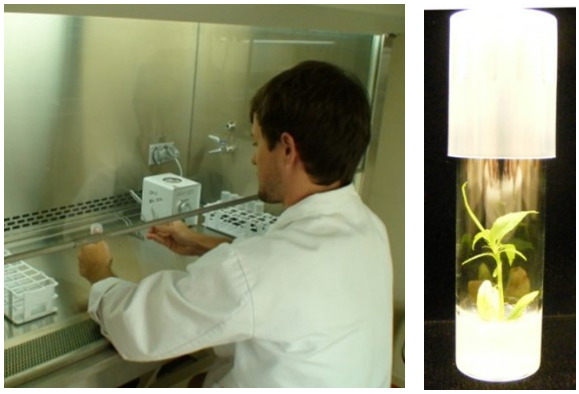
Breeder profile: Ksenija Gasic

By Audrey M. Sebolt, Project Assistant

Ksenija Gasic, Clemson University, showing off her wares

Resistance to brown rot (left) and bacterial spot (right) are key target traits that Ksenija Gasic emphasizes in her breeding program.

Red (left) and yellow (right) flesh colors are both breeding goals for Ksenija's program.



A research assistant in Ksenija's lab performs embryo rescue; the image on the right is of a rescued seed in tissue culture.

South Carolina's peach industry considers itself the "Tastier Peach State". Consumers wholeheartedly agree with this slogan and the numbers support this claim. South Carolina is ranked second (behind California) for fresh market peach production. In an average year, South Carolina produces 200 million pounds of peaches, valued at $35 million. Consumers are able to enjoy a continuous supply of summer peaches, consisting of 30-40 cultivars that ripen from June to September. However, consumers increasingly demand excellent quality fruit and their taste preferences continue to change. South Carolina peach growers, in order to remain profitable, must meet consumer demands while dealing with numerous abiotic and biotic stresses that can affect production. In 2008, Clemson University hired Ksenija Gasic to revive a breeding program that had been dormat for 25 years and to breed new peach cultivars that meet the demands of the consumer yet provide the highest return on investment for growers.

Breeding for the perfect peach Ksenija's aim is to combine bacterial spot and brown rot tolerance (or preferably resistance) with large fruit that are of excellent quality. Fruit quality traits desired include round, large, firm fruit, melting flesh, freestone, and increased sugars and nutritional value. These traits are to be packaged in skin with a yellow ground color and an intense blush overcolor. Critical production traits include early and late maturing fruit (widening the ripening season), reliable cropping, optimal bloom density, scab resistance, drought tolerance, and freeze tolerance. Of these traits, the evaluation of early-maturing fruit is challenging and labor- and time-prohibitive because embryo-rescue must be performed. All of the seeds from Ksenija's crosses must be embryo-rescued after they are harvested because the fruit from early-ripening female parents ripen before the embryo has had a chance to fully develop.

Ksenija uses various pollen sources for her crosses from William Okie's (Byron, GA) breeding program, Dennis Werner's (North Carolina State University) advanced selections, Brazilian landraces courtesy of Maria Bassols Raseira, and Italian landraces courtesy of Tiziano Caruso and Daniella Giovanini. In a given year, Ksenija evaluates approximately 5000 seedlings, which are planted at Clemson University's Musser Research Farm, located in Seneca, SC.

Ksenija maintains a close working relationship with South Carolina's peach industry to ensure her breeding program goals align with the changing needs of growers and consumers. To facilitate this relationship, Titan Peach Farms, located in Ridge Spring, SC, serves as a second test site (Musser Research Farm is the first) for commercial cultivars. These cultivars are evaluated for ripening stage at commercial harvest time and fruit are packed on a packing line. In addition to commercial cultivars, fruit from RosBREED's Crop Reference Set are also evaluated for phytochemical components and their differences between years, locations, and harvesting times. Chalmers Carr III is Titan Peach Farms' President and CEO as well as a RosBREED Industry Advisory Panel member. For RosBREED, he represents the Southeast peach grower community and ensures that their concerns

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Seedlings that have been embryo-rescued are grown in a greenhouse.

Seedlings planted at the Musser Fruit Research Farm, located in Seneca, South Carolina.

and needs are vocalized to the Rosaceae breeding and community of scientific support. In a previous interview with RosBREED, Chalmers stated that he felt that the peach industry is in need of great tasting, high-quality fruit that can be broadly grown on a consistent basis. Additionally, he is supportive of using new genetic knowledge to more efficiently and quickly meet these goals.

RosBREED's effort towards marker-assisted breeding Ksenija is the team leader for the RosBREED Peach Breeding Team. The RosBREED Demonstration Peach Breeding programs include Clemson University, Texas A&M (Dave Byrne), UC Davis (Tom Gradziel), and the University of Arkansas (John Clark). As team leader, Ksenija coordinated the efforts of prioritizing and constructing the Crop Reference (CR) and Breeding Pedigree (BP) Sets that were phenotyped and genotyped. The CR and BP Sets for peach consist of 953 peach cultivars, ancestors, and representative seedlings from all four peach Demonstration Breeding Programs. The CR and BP Sets were phenotyped during the 2010, 2011, and 2012 seasons under standardized protocols, which focused on fruit quality. This data is now available in the RosBREED Breeders' Toolbox. Traits and methods for generating this data have recently been published. Terrence Frett, Ksenija's past graduate student, is the lead author of this manuscript, titled, "Standardized phenotyping for fruit quality in peach [*Prunus persica* (L.) Batsch]" for which he won the U.P. Hedrick award from the American Pomological Society. Co-authors include John Clark, Dave Byrne, Tom Gradziel, and Carlos Crisosto.

Towards genotypic data, SNP arrays have been developed as a collaborative effort and a manuscript describing the development and validation of the peach SNP arrays was published this past April (2012) in PLoS One with Ksenija as a co-author. The RosBREED peach team generated 7,761,232 peach SNP data points for the 953 CR and BP Set individuals and Ksenija and Terrence Frett compiled and quality-checked much of this data. Ksenija and Terrence have also led the efforts in QTL discovery.

This past October, Ksenija and Greg Reighard hosted a successful Peach Breeder Workshop (see page 1). One of the presentation series, titled "Jewels You Can Use", showcased a peach "Jewel" for maturity date. This jewel was first described in our August 2012 newsletter. Maturity date is a critical trait because peach breeders aim to target cultivar development for specific maturity dates to fill gaps held by less desirable cultivars. At the Peach Breeder Workshop, Ksenija described the functional haplotypes that have been defined for this trait and how DNA diagnostic markers can be used to more efficiently breed for maturity date.

During the workshop, Ksenija also defined haplotypes for bacterial spot. Bacterial spot is a serious disease of peach because it can severely defoliate a tree, which can then reduce yield and blemish the fruit, making it unmarketable. Ksenija's lab has discovered 14 QTLs associated with bacterial spot. For five of the major QTLs, haplotype information is available. Haplotypes from resistant parents clearly contribute to the higher fruit tolerance/resistance of bacterial spot in peach.

The Peach Team are currently working towards converting the trait locus SNPs into markers that can be routinely run (i.e. the 2x 24-SNP mini-arrays). The team will soon be submitting leaf tissue from 390 cultivars, ancestors, and representative seedlings to a DNA diagnostic service provider, who will analyze a set of converted SNP markers which are associated with bacterial spot, maturity date, acidity, fruit size, and sweetness, and softening characteristics including slow melting flesh, blush, and flesh browning. For further details, see Cameron's article on the next page.

This coming spring, Ksenija will use RosBREED's Cross Assist tool to maximize her crossing efficiency. Cross Assist will inform her about which peach selections are the best crossing parents based on her traits of interest.

Frett T, Gasic K, Clark J, Byrne D, Gradiel T, Crisosto C. 2012. Standardized phenotyping for fruit quality in peach [*Prunus persica* (L.) Batsch]. Journal of the American Pomological Society 66(4):214-219.