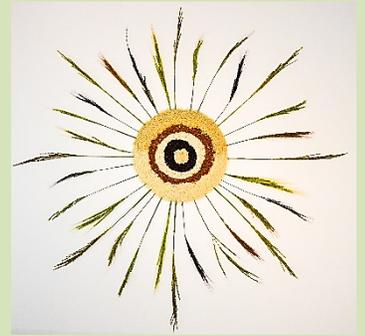




**Dale Bumpers National Rice Research Center
USDA-ARS
Stuttgart, Arkansas**



JANUARY 2022

MONTHLY RESEARCH HIGHLIGHTS

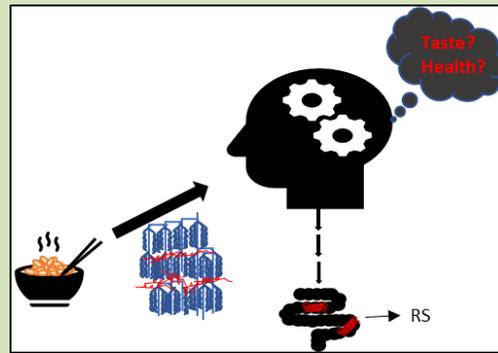
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- **Recent Scientific Publications**

This addresses USDA-ARS Research Goal: Germplasm with enhanced nutritional quality for the consumers, the rice producers and food industry.

Chen, M.-H., Bett-Garber, K., Lea, J., **McClung, A.M.,** Bergman, C.J. 2022. High resistant starch rice: Variation in starch related SNPs and functional and sensory properties. *Foods*. <https://doi.org/10.3390/foods11010094>.

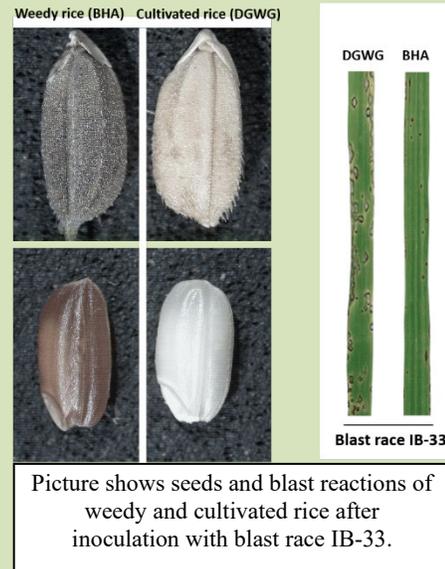
Human diets containing greater dietary fiber are associated with superior glycemic control and preventing chronic diseases. Resistant starch (RS) is the primary form of dietary fiber in cooked milled rice. Although high amylose rice has higher RS than lower amylose content varieties, sensory and processing properties associated with RS have not been evaluated. We evaluated the processing properties and sensory quality of cooked rice of eight global varieties that were identified as having the highest RS in a previous study. For comparison, two representative US high amylose varieties were included. Trained panelists using descriptive sensory analysis determined that only two of 14 cooked rice texture attributes were different between the high RS group of varieties and other high amylose US varieties. Roughness was the only texture attribute associated with RS content, while protein content influenced roughness and stickiness between grains. Moreover, in an evaluation of the functional properties, few differences were found between the high RS varieties and US varieties that have similar parboiling quality. These results demonstrate the potential for increasing RS in US rice varieties that enhances the health benefits of consuming rice while having minimum impact on cooked rice texture or processing quality.



This addresses USDA-ARS Research Goal: New methods to effectively recombine genomes and introgress useful alleles and novel diversity.

Haijun Zhao, Yan Liu, **Melissa H Jia**, and **Yulin Jia**. 2022. An Allelic Variant of the Broad-Spectrum Blast Resistance Gene *Ptr* in Weedy Rice is Associated with Resistance to the Most Virulent Blast Race IB-33. *Plant Disease*. <https://doi.org/10.1094/PDIS-09-21-2043-RE>

Rice resistance (*R*) genes have been effectively deployed to prevent blast disease caused by the fungus *Magnaporthe oryzae*, one of the most serious threats for stable rice production worldwide. Weedy rice, competing with cultivated rice, may carry novel or lost *R* genes. In the present study, we examine the resistance mechanism of weedy rice to *M. oryzae* using machine learning. The *Ptr* gene in rice encodes a predicted protein with four armadillo repeats and confers a broad spectrum of blast resistance except for race IB33. A blast resistance QTL *qBR12.3b* was previously mapped at the *Ptr* locus in a black hulled awned weedy strain using a weed-crop mapping population under greenhouse conditions. A gene-specific marker was developed from *Ptr* to distinguish alleles in weed and crop. The existence of the *Ptr* gene in 207 individuals of the same mapping population was examined using this gene-specific marker. Disease reactions of 207 individuals and their parents to IB33 were evaluated. The resistant individuals had the *Ptr* whereas the susceptible individuals did not. Sequence analysis of the product of the *Ptr* gene from weedy rice, Ptr^{BHA} , identified a unique amino acid glutamine (Gln) at protein position 874. **Using machine learning** minor changes of protein structure of the Ptr^{BHA} gene were identified. These findings are useful to determine pathogen recognition specificity of the Ptr^{BHA} gene mediated disease resistance signaling pathways and incorporate weedy allele Ptr^{BHA} into rice breeding programs for enhanced blast resistance using marker assisted selection.



Picture shows seeds and blast reactions of weedy and cultivated rice after inoculation with blast race IB-33.

- **Technology Transfer**

- ✓ **Interactions with the Research Community**

DBNRRC scientists, Drs. Yulin Jia, Anna McClung and Georgia Eizenga participated in the Plant and Animal Genome Conference XXIX held Jan. 8-12, which was changed to a virtual conference due to rising covid cases on Jan. 5. As part of the conference Dr. McClung presented ‘*Utilization of the USDA-ARS Germplasm Collection in US Rice Breeding Programs*’ in the “Rice as a Model for Genetics, Genomics and Breeding” workshop which had 42 participants. This workshop was organized and chaired by Dr. Jia. Georgia was scheduled to present ‘*Exploring Relationships Between Phenotypic Groups and Genotypic Subpopulations in Ancestral Rice, the Oryza rufipogon Species*

Complex (ORSC)’ in the “Genomics of Gene banks” workshop but due to technical difficulties, the workshop organizers decided to postpone the workshop until 2023.



Value of Using USDA Rice Germplasm Resources in Breeding

- Traits/genes are not present in the narrow US genepool- sterility restorers
- Capture new grain qualities for high value markets: basmati, jasmine, risotto, Japanese premium quality, high amylose, resistant starch, protein
- New threats: new pests, new biotypes of existing pests, impacts of climate extremes
- New production systems: alternate wetting and drying, upland, organic
- *Most of the germplasm is not restricted by IP*

The value of the USDA-ARS Rice Germplasm Collection (Dr. Anna McClung)

On January 19, 2022, Dr. Trevis Huggins shared updates about the National Small Grains Center (NSGC) rice germplasm and Genetic Stocks *Oryza* (GSOR) germplasm at the Rice Breeder’s meeting. The updates included information about addressing redundancy and true-to-type issues in the NSGC collection. The breeders were also informed of the six new phenotypic traits that have been added to GRIN and the genotyping of the low inventory and redundant by name accessions. The attendees were also informed of the two new sources of genetic diversity that will be added to the collection in the next two years.

✓ Rice Germplasm Distributed

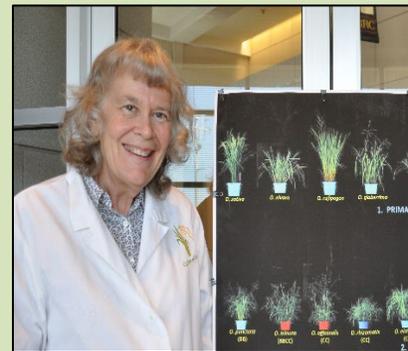
During the months of December and January, 1,990 rice genetic stocks were shipped to researchers in the United States and Germany from the Genetic Stocks *Oryza* (GSOR) collection.

- **Education and Outreach**

On January 14, 2022, DBNRRC donated 64lbs of milled rice to the Stuttgart, AR. Food bank



Georgia Eizenga, a Research Geneticist at the DBNRRC, grew up in the Chicago area as the eldest of six children. She decided to major in science in 6th grade after a long discussion with her parents because she had to write a school report on “what she wants to be when she grew up”. After further thought Georgia decided she liked Biology the best and became interested in agriculture because it had a practical application. As a H.S. freshman, Georgia did a science project on the impact of nitrogen levels on the growth of beans and begonias for which she competed at the state level. Later, after a discussion with her high school calculus teacher, she decided to get her M.S. Subsequently, discussing this plan with her father while preparing the family garden, he predicted she would get a Ph.D., which she denied profusely (nine more years of school was too much school!). As a freshman, Georgia attended Calvin Univ. as a Biology major with plans to transfer because agriculture classes were not offered. Since the internet did not exist, Georgia researched agriculture via the college catalogues in the library and wrote letters to several universities. It was rewarding to have mail most every day for a while. Subsequently, Georgia decided on the Univ. of Illinois and went for a visit with her father. During this visit she learned about applying for lab jobs based on her mother’s suggestion. To make sure she had the best chance to get a lab job, Georgia went a week before the dorms opened and put in several applications. She was overjoyed to get a job in a plant physiology lab in the Agronomy Dept. After discussions with the two professors she worked for, Georgia decided to focus on genetics and plant breeding in graduate school. She chose to attend the Univ. of Missouri-Columbia and work with the E.R. Sears, a world-renown USDA-ARS wheat cytogeneticist (Cytogenetics is the study of chromosome behavior in meiosis and mitosis). Georgia’s Ph.D. focused on shortening the chromosome segment from the wheat wild relative *Agropyron elongatum* which had a novel gene for leaf rust resistance, so this could be more easily incorporated into elite wheat breeding lines (during this time,



Georgia also met her husband, Jim Worstell, who also did his Ph.D. with Dr. Sears). After finishing her Ph.D., Georgia did a short Post-doc in plant Physiology at the Univ. of Kentucky (UK) before accepting the ARS cytogenetics position on the UK campus, working on tall fescue hybridization to improve the forage quality, so beef cattle would gain more weight. In 1995, the ARS Tobacco and Forage program was closed, and Georgia was assigned to a position in the rice germplasm group at Stuttgart, as part of the soon to be built National Rice Germplasm Evaluation and Enhancement Center (NRGEEC), later renamed the DBNRRC. Subsequently, Georgia began developing a program to explore the value of both rice wild species and unadapted, diverse cultivars for rice improvement, and developing novel genetic resources for fundamental research to enhance understanding of rice genetic structure.

Quynh Grunden joined the Dale Bumpers National Rice Research Center as a Biological Science Technician in Cytogenetics for Dr. Georgia Eizenga in January 2000. Before joining the USDA, Quynh worked for the Food and Drug Administration (FDA) in Maryland as a Lab Technician. She also worked in Dr. Fleet Lee's Plant Pathology Lab at the University of Arkansas Rice Research Extension Center evaluating rice blast and sheath blight diseases. While working at Dale Bumpers she has worked on specific bacterial artificial chromosome clones using an *in situ* hybridization procedure to identify IR36 rice trisomic lines; helped develop methods for evaluating wild rice relatives and their reaction to blast disease; and made breeding crosses to develop several rice mapping populations for cold tolerance, sheath blight and blast resistance studies. She has also assisted with rice cold tolerance, salt tolerance and yield evaluations. Throughout her 22 years at DBNRRC, her technical assistance has been acknowledged in numerous scientific publications. Additionally, Quynh has been involved in many outreach programs with hands-on demonstrations and activities. She has judged local high school science fairs, been a member of the Stuttgart Council for Employee Engagement, Diversity, Inclusion and Outreach, and helped to organize Asian, Hispanic, Black History months and Women Equality Day programs. She also served 4 years on the Stuttgart Public Library Board of Directors.



During her free time, she enjoys spending time with family, running, working out, biking, sewing, gardening, and playing music.

See the web version of all DBNRRC research highlights at: <https://www.ars.usda.gov/southeast-area/stuttgart-ar/dale-bumpers-national-rice-research-center/docs/monthly-research-highlights/>