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

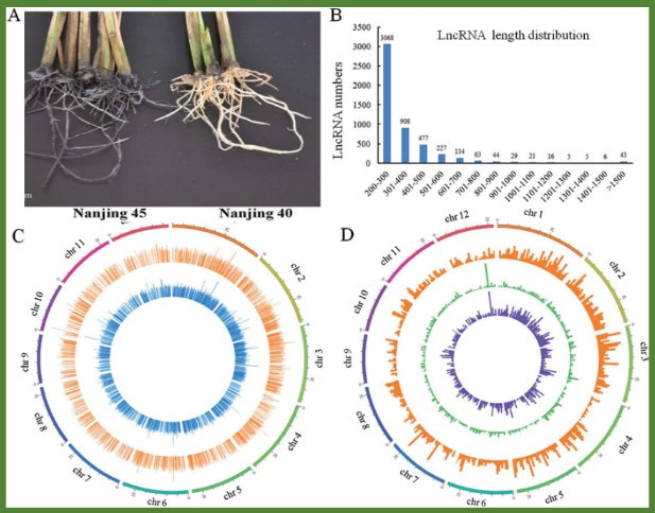
NOVEMBER 2018

MONTHLY RESEARCH HIGHLIGHTS

For More Information: Dr. Anna McClung, Research Leader/Center Director
anna.mcclung@ars.usda.gov

- **Recent Scientific Publications**

Wenqi Li, **Yulin Jia**, Fengquan Liu, Fangquan Wang, Fangjun Fan, Jun Wang, Jinyan Zhu, Yang Xu, Weigong Zhong, Jie Yang. 2018. Genome-wide identification and characterization of long non- coding RNAs responsible to *Dickeya zeae* in rice. RSC Advance. Published on 08 October 2018.



Disease reactions of rice foot rot disease [(resistant Nanjing 40 versus susceptible Nanjing 45) (A)]. distributions of LncRNAs (B-D).

Rice foot rot disease caused by the bacterial pathogen *Dickeya zeae* is a destructive disease threatening rice yield and quality. Plant non-coding RNAs (lncRNAs) are known to be involved in plant stress response but their relationship to plant disease resistance is unknown. In the present study, whole transcriptome sequencing (RNAseq) was used to investigate the abundance of these plant non-coding RNAs in rice roots in response to infection by the bacterium. A total of 4,709 lncRNAs were identified of which 2,518 were up-regulated (increased) and 2,191 were down-regulated (decreased). Five of the increased lncRNAs were associated with genetic targets that are known stress response genes suggesting that these lncRNAs degrade the transcripts of target genes leading to effective disease resistance. These findings reveal new molecular mechanisms of plant innate defense response to a bacterial pathogen which may help in developing disease resistant rice varieties.

This addresses USDA-ARS Research Goal: Development of crop plants with resistance to diseases.

Huang, X., Liu, H., **Pinson, S.R.M**., Lin, H.-X., Guerinot, M.L.. Zhao, F.-J.. Salt, D.E. 2018. Natural variation in a molybdate transporter controls grain molybdenum concentration in rice. New Phytologist doi.org/10.1111/nph.15546. https://nph.onlinelibrary.wiley.com/doi/epdf/10.1111/nph.15546

Rice provides about one fifth of the daily calories for more than half of the world's population as well as provides a critical source of essential mineral nutrients. The objective of this study was to identify the gene associated with large differences in concentrations of the element molybdenum (Mo) in the grain. Molybdenum is an essential micronutrient for both plants and animals, and is predominantly active as a Mo-containing coenzyme (MoCo). Although cases of Mo deficiency in humans are rare, Mo deficiency is fairly common in plants and is associated with acid soils. A QTL affecting grain-Mo accumulation previously discovered on rice chromosome 8 was fine mapped and DNA sequence information used to identify candidate genes. To determine which of the candidate genes controlled grain-Mo, we studied rice progeny containing genetic mutations in the structural and promoter regions of the various candidate genes. The mutations studied included sequence alterations that changed the protein structure, the amount of protein made, and where the protein was stored in plant cells. We ultimately determined that the causal gene is *OsMOT1;1,* and that it affects the amount of Mo transported to leaves and grains by affecting how much Mo is retained in root mitochondria, which in turn affects how much MoCo is produced. We further determined that differences in Mo transport were not due to structural differences in the *OsMOT1;1* protein but were due to differences in the gene promoter region causing different amounts of protein to be produced. The identification of *OsMOT1;1* provides an important insight into the regulation of Mo in plant cells and is a useful gene to breed into crop plants that are grown on Mo deficient in soils.

Blue coloration indicates strength of *GUS* gene expression when driven by the *OsMOT1;1* promoter. Gene expression was strongest in root tips and hairs, with little to no expression found in stems, leaves, and panicle tissues.

This addresses USDA-ARS Research Goal: Development of crop plants tolerant to environmental changes.

- **Technology Transfer**

  ✓ **<u>Interactions with the Research Community</u>**

  On November 11th, a report on the genetic marker results performed on 238 advanced breeding lines being evaluated in the Uniform Regional Rice Nursery was provided to southern US public breeders that are cooperators in this project. The data provided information on markers linked to four quality traits, four disease resistance genes, and two agronomic traits. This information helps the breeders identify the best breeding lines

that may warrant public release as a variety for commercialization and production by US rice growers.

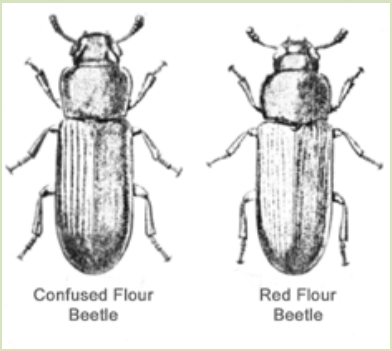
✓ **Rice Germplasm Distributed**

During November, 1,591 rice accessions from the Genetics Stocks *Oryza* (GSOR) collection were distributed to researchers in the United States.

On November 30th, seed of three diverse rice varieties were sent for use in the Smithsonian Museum Gardens in Washington, DC.

- **Stakeholder Interactions**

On November 30th, Dr. Ming Chen facilitated connecting Dr. John Bernhardt (retired UAR entomologist) with the Federal Grain Inspection Service (FGIS) office in Stuttgart to help in identifying and confirming stored grain pests in rice samples including the confused flour beetle and the red flour beetle.



On Nov. 15-16th, the British Broadcasting Company (BBC) science department team visited with Dr. Jinyoung Barnaby of DBNRRC (but currently at the Beltsville, MD location) and Dr. Lewis Ziska, ARS Alternative Cropping Systems Lab in Beltsville to learn about rice research being conducted on the possible impacts of climate change. Dr. Barnaby demonstrated her ongoing research studies to understand the impact of heat stress in addition to an elevated CO2 level of 600 ppm, which is the predicted atmospheric CO2 level around the year 2050, on grain chalk formation using various rice progeny known to differ in chalkiness. Dr. Ziska discussed how increased CO2 could affect future food production and nutritional value. The film is planned to be internationally broadcast on the channel BBC One early next year.

- **Education and Outreach**

On November 2nd, Dr. Georgia Eizenga participated in the "Career Expo" attended by 88 seniors from DeWitt High School and sponsored by Phillips Community College-Univ. Arkansas-DeWitt. She gave a short overview of employment opportunities in USDA-ARS, which included a description of the salaries and education needed for various positions and summer employment opportunities for students. Handouts of research activities at the DBNRRC, contact information, and job applications were distributed to interested students. A slideshow of DBNRRC research activities was on display, as well as, rice varieties from around the world, and various food products made from rice.

On November 9th, Dr. Paul Moushumi graduated from 2018 career development program (CDP) for high performers at the USDA building in Washington, DC. The CDP is a tuition-free program that offers individual mentoring, professional development, and career counseling for high-performing federal employees sponsored by the Federal Asian Pacific American Council (FAPAC). Dr. Yulin Jia of the DBNRRC served as his mentor during the 6-month training period.