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

MARCH 2019

MONTHLY RESEARCH HIGHLIGHTS

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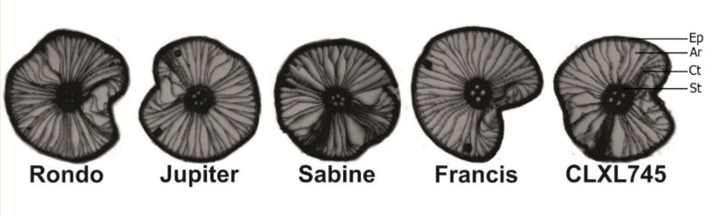
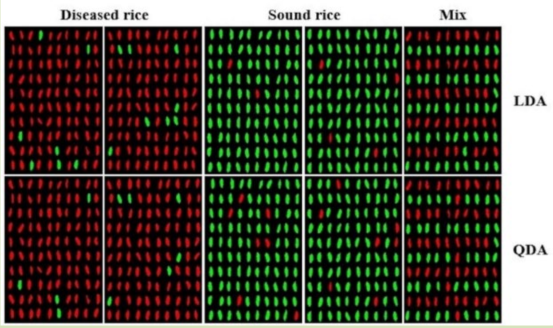
- **Recent Scientific Publications**

Kim, W.J., L.T. Bui, J.B. Chun, **A.M. McClung**, and **J.Y. Barnaby** 2019 Correlation between Methane (CH_4) Emissions and Root Aerenchyma of Rice Varieties. Plant Breeding and Biotechnology 6:381-390 https://doi.org/10.9787/PBB.2018.6.4.381



Aerenchyma is a spongy tissue containing intercellular air spaces in some plants, especially in aquatic and wetland plants. Percentage of aerenchyma area has been closely linked with amounts of methane emitted by rice. A diversity panel of 39 global rice varieties was examined to determine genetic variation for root transverse section (RTS), aerenchyma area, and % aerenchyma. RTS and aerenchyma area showed a strong positive correlation while there existed no significant correlation between RTS area and % aerenchyma. Five varieties previously shown to differ in methane emissions under field conditions were found to encompass the variation found in the diversity panel for RTS and aerenchyma area. These five varieties were evaluated in a greenhouse study to determine the relationship of RTS, aerenchyma area, and % aerenchyma with methane emissions. Methane emissions at physiological maturity were the highest for ‘Rondo’, followed by ‘Jupiter’, while ‘Sabine’, ‘Francis’ and ‘CLXL745’ emitted the least. The same varietal rank, ‘Rondo’ being the largest and ‘CLXL745’ the smallest, was observed with RTS and aerenchyma areas. RTS and aerenchyma area were significantly correlated with methane emissions; however, there was no relationship with % aerenchyma. Our results demonstrated that varieties with a larger root area also developed a larger aerenchyma area, which serves as a gas conduit, and as a result, methane emissions were increased. This study suggests that root transverse section area could be used as a means of selecting germplasm with reduced CH_4 emissions.

Baek, I.S., M.S. Kim, B.K. Cho, C.Y. Mo, **J.Y. Barnaby**, **A.M. McClung**, and M.R. Oh 2019 Selection of optimal hyperspectral wavebands for detection of discolored, diseased rice seeds. Applied Science 9(5):1027 https://doi.org/10.3390/app9051027



Increasing incidence of bacterial panicle blight (BPB) disease has been reported and it has become a major bacterial disease in rice which is associated with changing climates, high night temperature with frequent rainfalls, and has resulted in yield losses as high as 40%. Investigations into identifying and quantifying incidence of BPB disease symptoms have been made, but information is still largely lacking. The objective of this study was to use a hyperspectral imaging (HSI) technique to find optimal wavelengths and develop a model for detecting discolored, diseased rice seed infected by bacterial panicle blight, a seedborne pathogen. For this purpose, the HSI data spanning the visible/near-infrared wavelength region between 400 and 1000 nm were collected for 500 sound and discolored rice seeds. For selecting optimal wavelengths to use for detecting diseased seed, a sequential forward selection (SFS) method combined with various spectral pretreatments was employed. To evaluate performance based on optimal wavelengths, support vector machine (SVM) and linear and quadratic discriminant analysis (LDA and QDA) models were developed for detection of discolored seeds. As a result, the violet and red regions of the visible spectrum were selected as key wavelengths reflecting the characteristics of the discolored rice seeds. When using only two or only three selected wavelengths, all of the classification methods achieved high classification accuracies over 90% for both the calibration and validation sample sets. The results of the study showed that only two to three wavelengths are needed to differentiate between discolored, diseased and sound rice, instead of using the entire HSI wavelength regions. This demonstrates the feasibility of developing a low-cost multispectral imaging technology based on these selected wavelengths for non-destructive and high-throughput screening of diseased rice seed.

- **Technology Transfer**

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

  On March 12, 2019, DBNRRC hosted Dr. Arlene Adviento-Borbe, Research Agronomist with USDA-ARS, Delta Water Management Research Unit, in Jonesboro, AR and a collaborator on alternate-wetting-and-drying (AWD) research project. Dr. Borbe presented a seminar entitled: " Do mitigation strategies reduce greenhouse gas emissions in US rice systems?". After the seminar, collaborative 2019 summer research plans were discussed with Dr. Anna McClung, Dr. Jinyoung Barnaby and Dr. Jai Rohila.

  On March 18, 2019, Dr. Jai Rohila at DBNRRC hosted Dr. Matthew Reid, Assistant Professor at Cornell University, Ithaca, NY and ARS collaborator on water management and arsenic availability in rice paddy soils. Dr. Reid presented a seminar entitled: “Effects of Alternate Wetting and Drying on Redox Cycling of Iron and Manganese in

Paddy Soils: Implications for (Im) mobilization of Arsenic”. After the seminar, Dr. Reid further discussed collaborative research with Dr. Anna McClung and Dr. Jai Rohila.

On March 19, 2019, Dr. Jia completed phenotypic evaluation of 28 selected breeding lines for blast resistance for Dr. Adam Famoso, a rice breeder from Louisiana State University Agricultural Center. H. Rouse Caffey Rice Research Station, Rayne, LA. Rice breeding lines predicted to contain three broad spectra blast resistance genes, Pi9, Pi42(t) and Pi43(t), were identified through DNA markers and their presence was then verified by Dr. Jia through assessment of disease reactions using four differential blast races, IE1k, IB54, IB49, and IC17 under greenhouse conditions. This is an ongoing research project between ARS and Dr. Famoso to develop breeding materials with broad spectrum resistance to this common disease in rice.

✓ **Rice Germplasm Distributed**

During March, 1,316 rice accessions from the Genetics Stocks *Oryza* (GSOR) collection were distributed to researchers in the United States.

Seedstocks of several ARS developed specialty varieties were provided to growers in SC, AR, MS, and MD for commercial production.

On March 11th, Dr. Anna McClung provided seed of 14 early maturing global rice cultivars to Dr. Sai Sree Uppala at the University of Massachusetts for testing as a possible alternative crop for cranberry production fields.

- **Stakeholder Interactions**

On March 4th, Drs. Anna McClung and Ming Hsuan Chen provided information to Mars (Uncle Ben’s) regarding rice varieties that have enhanced nutritional properties.

On March 20th, Dr. Anna McClung provided information on genetic markers linked with blast resistance genes and rice varieties that possess these disease resistance genes to Ken Foster, private rice breeder in California.

- **Education and Outreach**

Ms. Evie Jackson won second place in the Southeast Arkansas Regional Science Fair on March 12, 2019 and will advance to the state science fair. The title of her project is “Using GWAS to Identify Salt Tolerance QTL in Soybeans”. She was mentored by Dr. Trevis Huggins and Aaron Jackson. Additional suggestions and material resources were provided by Dr. Anna McClung, Dr. Georgia Eizenga, and Laduska Simpson.