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

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MONTHLY RESEARCH HIGHLIGHTS

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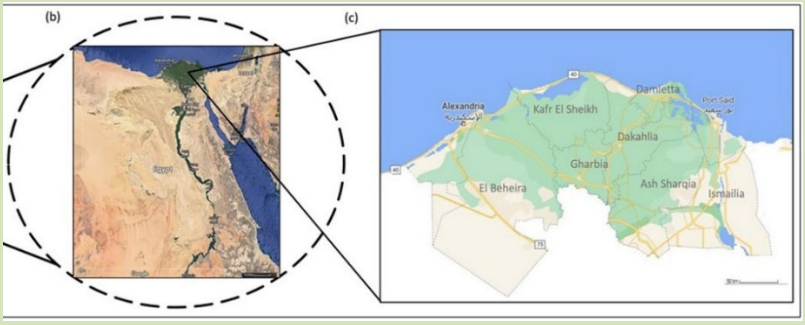
- **Recent Scientific Publications**

This addresses USDA-ARS Research Goal: Crop plants with enhanced water and input-use efficiencies

Abdelrahman, M.A.; Emadeldin, Y.; **Rohila, J.S.**; Karthikeyan, R. Impact of Genetic Improvements of Rice on Its Water Use and Effects of Climate Variability in Egypt. Agriculture 2021, 11(9): 865. https://doi.org/10.3390/agriculture11090865

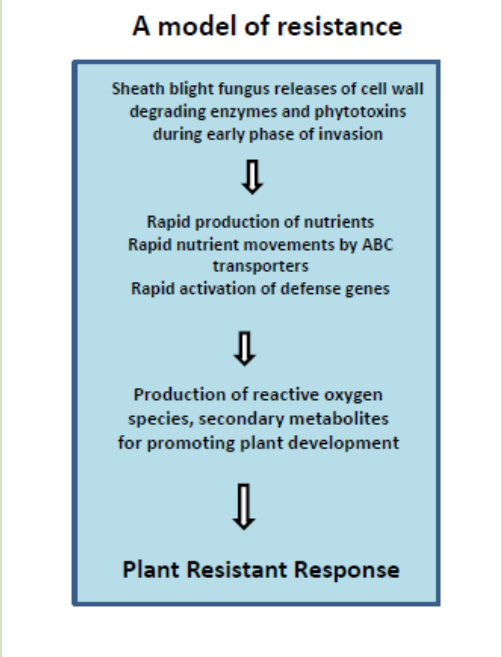
Natural resources are limited for crop production and there is a need to use marginal agricultural lands and reduced water resources to sustain rice production to feed the world. Genetic improvements and the release of improved rice varieties will aid in meeting this challenge. Egypt relies only upon the Nile River all of its freshwater supply. To remain competitive in rice production, rice breeders have aggressively improved Egyptian rice varieties for reduced water requirements. We analyzed data for the last two decades to understand the impacts of climate variables, improved cultivars, and various cultivar substitution scenarios as a case study in productivity trends. In general, rice acreage and total production have decreased over time. An in-depth analysis of data demonstrated that while some late maturing varieties had greater yield, early maturing varieties had higher water productivity (i.e. the amount of water used to produce a ton of rice). Using a classical cultivar substitution analysis it was found that improved cultivars (e.g., Giza179, Sakha 107) that were of short duration (days to maturity = 122) and were higher yielding (9.26 metric ton/ha) were capable of providing higher net savings on water (795.55 thousand m^3) compared to the average of the popular cultivars. In addition, the typical weather pattern in Egypt is characterized by more precipitation during off-season than during the growing season. Using autoregressive distributed lag (ARDL) model, long-term and short-term effects of certain climate variables on rice production were analyzed and results demonstrated that on- and off-season precipitation had mainly long-term impacts, but relative humidity during the rice growing season had greater short-term impacts possibly due to affecting physiology of the plant via vapor pressure deficit. Overall, the results indicated that short duration and higher yielding varieties could be one of the effective ways to increase rice production by using less irrigation water.



Pictured: (b) location of the Nile River Delta in northern Egypt; and (c) the study areas in the rice-growing areas.

This addresses USDA-ARS Research Goal: Enhanced understanding of the biochemical pathways and metabolic processes that underpin crop traits and improvement

Youngjae Oh, Seonghee Lee, Renee Arielle Rioux, Pratibha Singh, **Melissa H Jia, Yulin Jia**, and Kirankumar Mysore. Analysis of Differentially Expressed Rice Genes Reveals the ATP-Binding Cassette (ABC) Transporters as a Candidate Gene Against the Sheath Blight Pathogen, *Rhizoctonia solani*. Phytofrontiers Published on September 30, https://doi.org/10.1094/PHYTOFR-05-21-0035-R.



Sheath blight disease, caused by the fungus *Rhizoctonia solani,* is one of the most devastating diseases of rice worldwide. However, resistance genes and the molecular mechanisms for resistance are not well understood. As a result, control of this disease largely depends on the use of fungicides. In the present study, a field isolate of the pathogen was used to inoculate a resistant rice cultivar 'Jasmine 85' allowing identification of 159 plant genes that were "turned on" and involved in the resistance response. Three genes, members of the ABC transporter gene family involved in the transport of substrates across cell membranes, were mapped to known chromosomal regions (QTL) linked with sheath blight resistance. These results suggest that the movement of secondary metabolites and plant hormones that regulate the overall plant development are involved in cells resisting invasion by the sheath blight fungus. Genetic markers were developed from these ABC transporter genes to distinguish between the sheath blight susceptible cultivar 'Lemont' and the resistant cultivar Jasmine 85. A random set of 77 progeny derived from a cross between these two cultivars were used to verify the initial findings. The *OsABC9* gene, located in a major sheath blight resistance QTL, qShB9-2, showed a major contribution to sheath blight resistance. These results have revealed a specific gene which will be useful in marker assisted selection to develop new sheath blight resistant cultivars and ultimately reduce the need for fungicide applications.

- **Technology Transfer**

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

    Drs. Shannon Pinson and Trevis Huggins served upon invitation on the ARS committee that formulated the new USDA-ARS research plan for National Program 301 which will be used to guide and prioritize research conducted during 2023-2027 on plant genetic resources, genomics, information management, bioinformatics, and genetic improvement.

  - ✓ **<u>Rice Germplasm Distributed</u>**

    During the month of September, 644 rice genetic stocks were shipped to researchers in the United States and Canada from the Genetic Stocks *Oryza* (GSOR) collection.

- **Stakeholder Interactions**

  On Sept. 3rd, Dr. Anna McClung, Research Geneticist, met with a rice producer and miller from South Carolina to evaluate pure seed production of new varieties developed by ARS at the Stuttgart, AR location.

  Dr. Jeremy Edwards, who is project lead for the Genomics and Bioinformatics group, provided information to a private breeder on Sept. 7th, about some of the most cost-efficient methods for genotyping rice breeding materials for use in marker assisted selection.

  In celebration of "September is National Rice Month", Arkansas Governor Asa Hutchinson, participated in a media event on Sept. 15th, in Atkins, Arkansas regarding the first shipment from the USA of long grain rice that went into China. The event was held at the Ralston Family Farms which produced and packaged the rice that was exported. The rice varieties that were in the shipment were developed by USDA-ARS researchers at DBNRRC for the specialty rice market. These included aromatic rice and varieties having unique red or purple bran which have been demonstrated to have health beneficial properties. (Pictured: L to R, Robin Ralston, Anna McClung, and Tim Ralston)

  On Sept. 28th, Dr. Flavio Breseghello with EMBRAPA, the federal rice and beans research program in Brazil, contacted Dr. Jeremy Edwards, Molecular Geneticist, on the best methods

for genotyping rice germplasm collections. Like the USA, most of the rice cultivars that are commercialized in Brazil are derived from the tropical japonica genepool and thus relevant genetic markers would be commonly used.

- **Education and Outreach**

  On Sept. 28th, Dr. Jinyoung Barnaby, Plant Physiologist with DBNRRC, served as moderator for the KWSE-KWiSE (South Korea and U.S.) Data/Eco Science Webinar for September. These webinar series are sponsored by the association of Korean Woman Scientists and Engineers.

  On Sept. 30th, Dr. Jinyoung Barnaby served as co-chair for the 4th Covid-19 forum "Monoclonal Antibodies as Therapeutics against SARS-CoV-2: From Development to Regulatory Approval" sponsored by Korea Foundation. About 200 scientists (government, Academia, industry group) from U.S. and South Korea participated the forum.

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/