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H. Rouse Caffey Rice Research Station News

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At the forefront of rice production research since 1909..

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SPECIAL DATES:

LSU AgCenter Winter Rice Production Meetings:

- Jan. 3, 2023--SWLA, Welsh Community Center
- Jan. 4 -- Evangeline Parish, Crawfish Barn, Vidrine, La.
- Jan. 5 -- Acadia, Acadia Parish Extension Auditorium, Crowley, La.
- Jan. 10 -- Vermilion, Vermilion Parish Extension Office, Abbeville, La.

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New promising low-GI, high-protein diabetic friendly rice lines on the horizon

Rice Genomics & Genetics

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Last year about 1.3 million people with diabetes rationed their insulin to save money, either skipping their prescribed doses, taking less than needed or delaying the purchase altogether. Deemed necessary for some, those actions, however, could threaten their health and even their lives. Carb-based food with lower glycemic index, such as the low-GI high-protein rice, can help avoid getting into these dilemmatic situations. Insulin-to-carb ratio determines how much rapid-acting insulin that needs to cover a specific amount of carbohydrates to accurately determine the dose of insulin for meals or to correct high blood sugars. The diabetes friendly rice produces more gradual rises, and therefore, flatten fluctuations in blood sugar and insulin levels due to slower digestion and absorption by the body.

The first low-GI high-protein rice that was developed at the Rice Research Station was Frontiere. Its glycemic index is 41, the lowest ever reported among rice on the market. Its GI makes this rice fall into true low-GI food groups. Rice in general has GI of 73 and therefore fallen into a high-GI food group. Because of that, people with diabetes--or other metabolic syndromes and obesity--were advised to avoid rice. With the low-GI high protein rice, people with these conditions can now safely eat rice again. Currently, the first low-GI high-protein rice is marketed under “Parish Rice” and “Cahokia”

The demand for this rice has grown enormously since its market introduction in December of 2021. In less

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Figure 1. Grain appearance of new low-GI high-protein milled rice.

This project was partially supported by USDA National Institute of Food and Agriculture and the Louisiana Rice Research Board.

Agronomy Field Trials

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Small plot trials examine yield effects of border rows

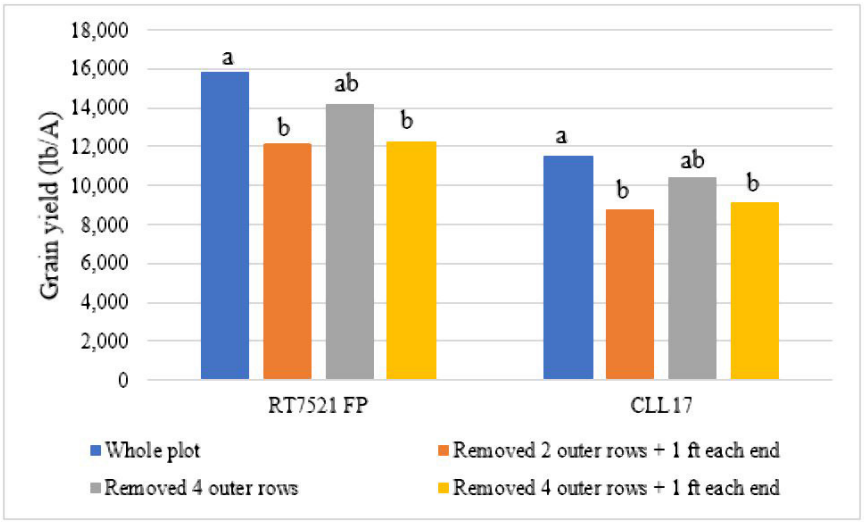

Figure 1. Effect of border rows on rice grain yield calculation for RT7521 FP and CLL17. Same letter above columns of each rice variety does not significantly differ (P=0.05, LSD).

Outer or side rows of a plot have advantages compared to inner rows in respect to environmental factors such as sunlight, aeration, and opportunity for carbon dioxide exchange, which result in greater photosynthesis. Numerous studies have reported that outer rows have significantly increased yield, plant height, tiller number, length of panicle, total grains per panicle, number of filled grains per panicle as compared to inner rows. This border effect can significantly impact the yield data, particularly in small plot trials. This is one reason why yield data from our trials are often higher than producers. This research was conducted to determine a factor to adjust yield data.

A field trial was conducted to quantify border effects on grain yield at the H. Rouse Caffey Rice Research Station. Three rice varieties: a) RT7521 FP, b) CLL17, and c) Titan were drill-seeded on March 14, 2022, at the seed rate of 10 seeds/sq ft for hybrid RT7521 FP, and 33 seeds/sq ft for CLL17 and Titan. The plot size was 4.67 x 16 ft and consisted of 7 rows with 8-inch space between rows with four replications. Phosphorus and potassium fertilizer were applied at planting at the rate of 60 lb/A of P2O5 and K2O. Nitrogen in form of urea was applied one-day before permanent flood establishment at the rate of 150 lb N/A for hybrid RT7521 FP, and 120 lb N/A for CLL17 and Titan. Rice plots were harvested on August 4, 2022. Four different harvesting methods were employed a) whole plot, b) harvest 5-middle rows excluding 1 foot at the end of both sides, c) harvest 3-middle rows, and d) harvest 3-middle rows excluding 1 foot at the end of both sides. Grain yield was adjusted to 12% moisture content.

Stand establishment for Titan was very poor due to burndown herbicides before planting; therefore, yield of Titan was not included in the analysis. Yields from the whole plot harvesting for both RT7521 FP and CLL17 were higher than the yield harvested without border row treatments (Figure 1). Harvesting from 5-middle row treatment without 1 ft of both ends or 3-middle row treatments without 1 foot of both ends resulted in 23.0% and 22.7% lower yields, respectively, as compared to the whole plot harvesting for RT7521 FP (Table 1). The differences also showed the

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	RT7521 FP		CLL17	
Harvesting method	Yield (lb/A)	Reduction (%)*	Yield (lb/A)	Reduction (%)*
Whole plot	15,867	-	11,578	-
5 middle rows excluded 1 ft each end	12,219	23.0	8,754	24.4
3 middle rows	14,202	10.5	10,462	9.6
3 middle rows excluded 1 ft each end	12,266	22.7	9,192	20.6

*% Reduction compared to the whole plot harvest.

Table 1. Small plot trial yield reduction calculations of rice field planted with hybrid RT7521 FP and Clearfield CLL17.

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than a year, it has become available in more than 200 grocery stores through-out the southern and mid-west regions of the U.S. Online stores have shipped the rice to customers in all 50 states. Just recently, the rice made it to the foreign export market of Haiti.

New advanced breeding lines of low-GI high-protein rice with greater yield potential are in the development. For example, two advanced long-grain cultivars--LG182 and LG465--respectively have GI of 42±7 and 41±8 and protein content of 11.4±1.4 and 11.8±1.1 (w/w). In comparison, Frontière has a GI of 41±9 and protein content of 10.4 ±1.2. These lines have good vigor and very early maturity (83-85 d to 50% heading). They are both semi-dwarf (95-96 cm tall) that are moderately susceptible to rice blast and susceptible to sheath blight with good yielding potential. LG182 and LG465 have respectively the main crop yield of 6,232 lbs/A and 6,555 lbs/A--which are higher than Frontière. They have excellent grain quality characteristics with high amylose content and intermediate gelatinization temperature based on lab and DNA marker analyses. Figure 1 shows the grain appearance of one of the promising lines. No conspicuous differences were found between this low-GI high-protein rice and typical U.S. long-grain rice such as Cocodrie or CL161. Their grain qualities fit the standards of U.S. long-grain rice recognized by consumers.

The low GI high-protein rice will extend the function of rice beyond its traditional role into more sophisticated functions in nutrition and other aspects of health benefits. This break-through rice type will help provide solutions to two major endemic problems, diabetes and obesity. With this new rice cultivar, people with diabetes can now eat rice safely and enjoy again their favorites cuisine, such as jambalya, etouffee, dirty rice and boudin. For Louisiana--and other states, as well--this is prominent, since more than 500,000 people in Louisiana are afflicted with diabetes and its mortality rate is ranked the fifth-highest in the nation. This epidemic in Louisiana costs $4.3 billion annually with an additional $1.5 billion in indirect costs from lost productivity.

This research is partially supported by LIFT2 – Leverage Innovation for Technology Transfer, LSU Boards of Supervisors, LSU Research & Technology Foundation,

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Figure 2. Going through head-row selections of low-GI high-protein rice lines.

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same trend for CL117, which were reduced 24.4, and 20.6 % in 5-middle row treatment without 1 ft of both ends and 3-middle row treatment without 1 ft of both ends, respectively. However, the yield from the harvest of 3-middle row treatment including both ends of the plot were 10.5 and 9.6 % lower than the whole plot harvesting for RT7521 FP and CLL17, respectively. The yields in this treatment indicated that both ends of the plot had significantly impacted yield calculation.

Preliminary data from this study indicate that small plots trials with plots 7 rows wide and 16 foot long could result in significant higher yields than those obtained on a field scale. The conversion factor for actual yield could be approximately 22-23% lower than the yield from small plot trials. However, the final adjustment factor will be investigated over multiple season trials to reduce the variation of environmental factors.

Dr. Manoch Kongchum serves LSU AgCenterassistant professor of soil science and agronomy.

Rice Crop Market Outlook

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U.S. milled & rough rice exports projected to decline for 2022/23

(11/16/2022) -- Very little has changed in the domestic rice market, with exports still slower than needed. Part of this is a demand problem, and a lesser problem is logistics. Barge traffic on the Mississippi and other rivers is being severely affected by the very low water conditions caused by the lack of rain in the Midwest and South this year

Rice futures were lower. Nearby January rice settled down 18 cents to $17.78, near the day's low of $17.76, after trading as high as $17.94. March rice settled down 18 cents to $18.04. Barring some fresh bullish fundamental news, this is not a market that seems to have much upside beyond $18. That could change if the war in Ukraine spreads and ignites broader concerns over food security.

The U.S. 2022/23 rice production forecast was lowered 1.1 million cwt to 164.3 million based on a slightly lower yield reported by USDA's NASS in its Crop Production report released on November 9. Long-grain 2022/23 production was lowered 0.9 million cwt to 131.7 million, 9 percent below a year earlier and the smallest since 2019/20. Medium- and short-grain production was lowered 0.2 million cwt to 32.7 million cwt, 31 percent smaller than a year earlier and the lowest since at least 1972/73, when NASS first reported U.S. rice production by class.

Total rice harvested area remains estimated at 2.18 million acres, 12.5 percent below a year earlier and the lowest since 1983/84. Harvested area is estimated to be less than a year earlier in

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all reported states except Louisiana and Texas, where harvested area is up slightly from 2021/22. California accounts for the largest annual decline in rice harvested area; at 255,000 acres, its total 2022/23 rice harvested area is the smallest since 1958/59. This is the second consecutive year of a sharp decline in California rice acreage, a result of a severe and prolonged drought, low reservoir levels, and water restrictions. California grows almost exclusively medium- and short-grain rice, typically accounting for around 75 percent of U.S. medium- and short-grain acreage. Much of the area decline in the Delta this year was due to extremely high corn and soybean prices just prior to planting that encouraged farmers to shift acreage out of rice, and the historically high input costs for rice production this year. Early season adverse weather in parts of the Delta further reduced plantings.

U.S. rice imports in 2022/23 are forecast at a record 45.0 million cwt, up 1.0 million from the previous forecast and 19 percent above a year earlier. Imports are expected to account for more than 30 percent of total domestic and residual use (excluding seed use) in 2022/23, the highest share on record. In September, the United States imported a near-record 168,510 tons (product weight) of rice, up almost 85 percent from both August and a year earlier. Imports of Thailand's jasmine rice, the largest source and category of rice imported by the United States, were up more than 40 percent from a month earlier. Imports of basmati rice from India were down slightly from a month earlier but were still well above the 2021/22 monthly average. Both jasmine and basmati imports are classified as long-grain.

U.S. 2022/23 all-rice exports are forecast at 71.0 million cwt, 4.0 million below the previous forecast, almost 14 percent below a year earlier and the lowest since 1991/92. The downward revision was largely based on sales and shipments through late October and expectations regarding shipments for the remainder of the market year. The U.S. rough-rice export forecast was again lowered 2.0 million cwt and is now projected at 25.0 million cwt. Rough-rice imports are projected to be 11.5 percent below a year earlier and are the lowest since 2000/01. Long-grain shipments to Latin America are expected to again account for nearly all of these exports, with the United States facing increasing competition from South American suppliers in the region, especially in Mexico, the top U.S. rough-rice export market.

U.S. 2022/23 milled-rice exports are forecast at 42.0 million, down 2.0 million cwt from the previous forecast, nearly 15 percent below a year earlier and the smallest since 1965/66. United States sales through late October to both Haiti—the largest market for U.S. long-grain milled rice—and Japan—the largest market for U.S. medium-and short-grain milled rice—were well below a year earlier. U.S. milled rice exports in 2022/23 are limited

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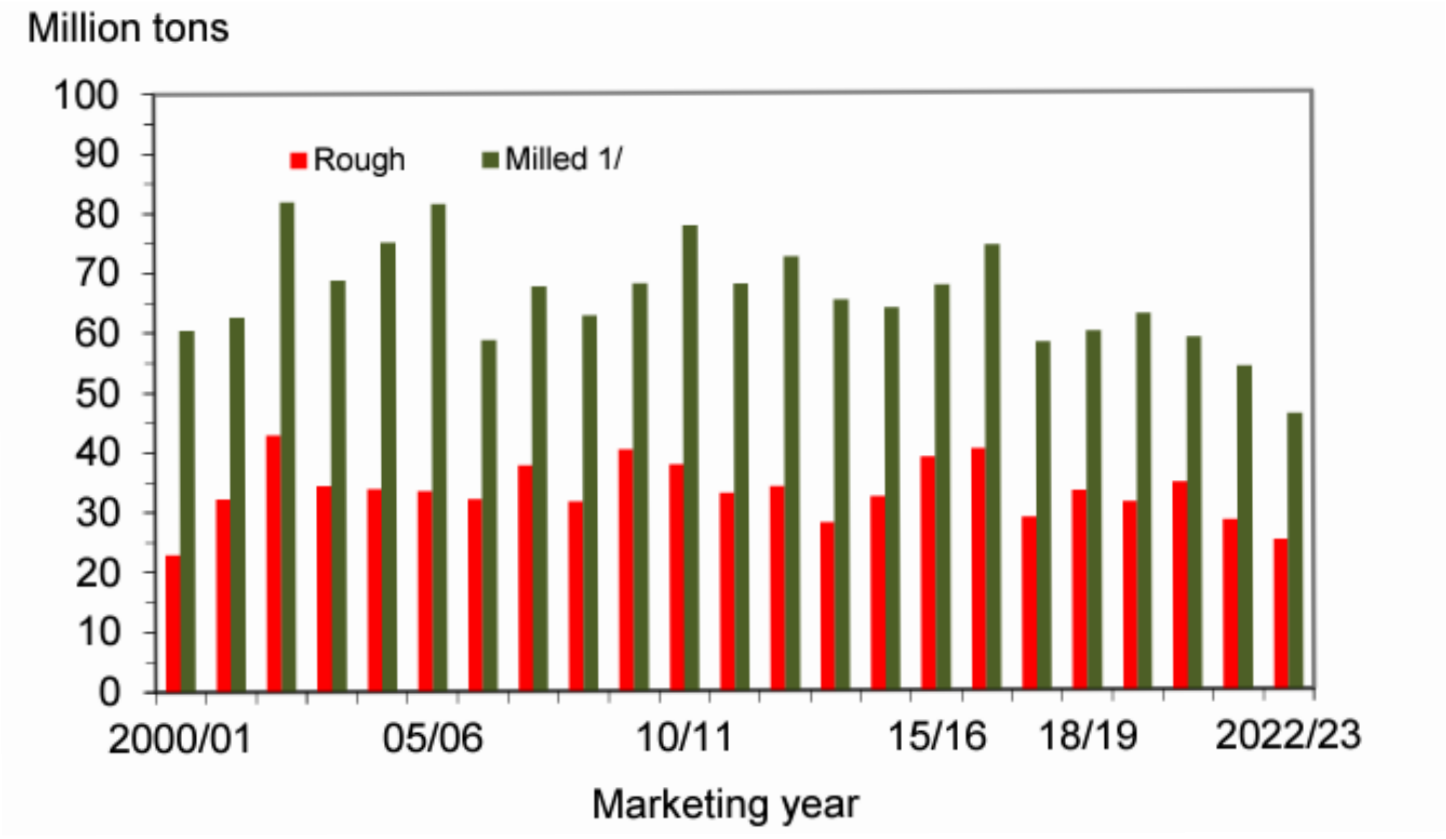

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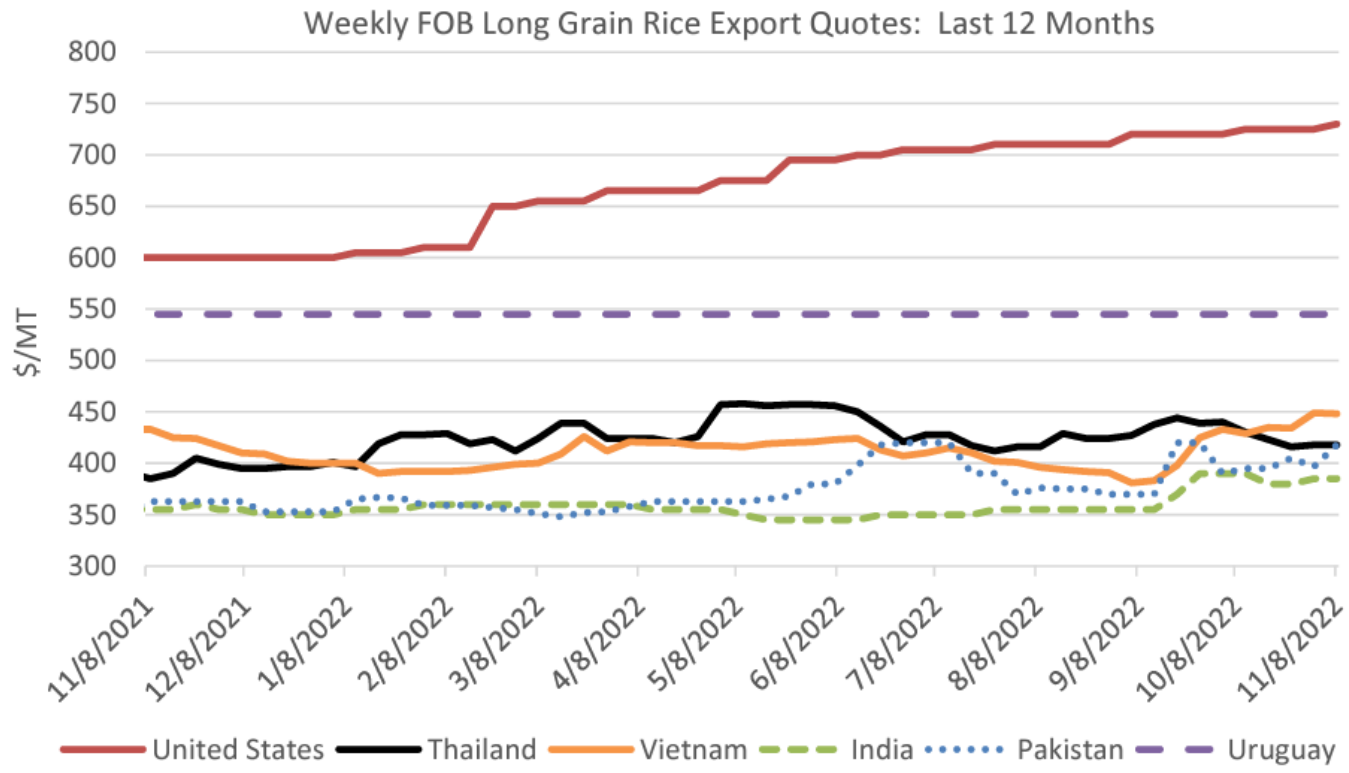
by high prices compared with those of suppliers in both South America and Asia.

Long-grain 2022/23 exports are forecast at 53.0 million cwt, 3.0 million below the previous forecast, nearly 13 percent smaller than a year earlier, and the lowest since 1987/88. Latin America is the largest market for U.S. long-grain exports, followed by the Middle East and Canada. The United States is facing increasing competition from several South American exporters in key Latin American markets. Medium- and short-grain exports are forecast at 18.0 million cwt, down 1.0 million from the previous forecast, 16.5 percent below a year earlier and the lowest since 2000/01. The United States is expected to make few sales of medium- and short-grain rice outside of its core markets in Northeast Asia, Jordan, and Canada due to record-high prices and very tight supplies. Through late October, U.S. sales and shipments to both Japan and South Korea were well behind a year earlier, a result of tight supplies in California and record-high U.S. prices.

The 2022/23 SAFP forecast for long-grain rice remains at a record $16.50 per cwt, more than 21 percent above the year-earlier revised estimate. The 2021/22 long-grain SAFP was lowered 10 cents to $13.60 per cwt. The U.S. 2022/23 all-rice SAFP is forecast at a record $19.90 per cwt, up 50 cents from a month earlier and almost 24 percent above the year-earlier revised estimate. The 2021/22 all-rice SAFP was raised 40 cents to $16.10 per cwt. Tighter U.S. rice supplies and high input prices are the major reasons for the expected higher—and typically record—U.S. rice prices in 2022/23. The 2022/23 southern medium- and short-grain SAFP is forecast at $17.40 per cwt, up 40 cents from the previous forecast and 25 percent above the year-earlier revised estimate of $13.90 and the highest since the 2008/09 record. The 2021/22 southern medium- and short-grain SAFP was lowered 20 cents per cwt but is still 7 percent above a year earlier.

In the past month, U.S. quotes went up by $5 despite the recent harvest and remains the highest among the major exporters at $730/ton. Uruguayan prices are unchanged at $545/ton. Vietnamese prices rose $19 to $448/ton amid tighter supplies and increased demand. Thai quotes declined $12 to $418/ton as a result of increased rice supplies from the new crop. Pakistani prices were up $23 to $418/ton with smaller supplies from the recent flooding. Indian quotes decreased $5 to $385/ton and remain the lowest globally.

Dr. Michael Deliberto serves as the LSU AgCEnter Rice Economist and as an assistant professor at the LSU College of Agriculture Department of Agricultural Economics & Agribusiness.



Focus: Dr. Roberto Fritsche-Neto

Quantitative geneticist steering Rice Breeding Program toward the future

LSU AgCenter Quantitative Geneticist Roberto Fritsche-Neto brings years of international plant breeding research to the H. Rouse Caffey Rice Research Station in Crowley. Using the latest technology in data collection and statistical modeling, Fritsche-Neto will aid in improving the effectiveness of the facility's Rice Breeding Program. Photo by Derek Albert/LSU AgCenter

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The recent addition of quantitative geneticist Roberto Fritsche-Neto to the faculty of the LSU AgCenter's H. Rouse Caffey Rice Research Station will further improve the facility's Rice Breeding Program with new ways to look at creating new rice cultivars.

Using quantitative genetics in the prediction-based breeding process represents a "paradigm shift" in the methods used to create new rice cultivars at the Rice Research Station, he said. Fritsche-Neto said the addition of himself and rice pathologist Felipe Dalla Lana, who also brings a quantitative approach to his research, demonstrates the ambitious plans for the future of the station. The addition of the quantitative geneticist to the faculty roster rounds off an illustrious, internationally staffed program that includes rice breeder Adam Famoso, molecular geneticist Herry Utomo and geneticist Brijesh Angira. But Fritsche-Neto said there are also other reasons why his arrival here was a welcomed evolution to his career. He gave the example of the role the Rice Research Station plays on the global scale.

"Rice is a vital crop to the world. It is important to the United States; it is important to Louisiana,

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Focus: Dr. Roberto Fritsche-Neto -- Continued from Page 7

but it's the kind of crop that is vital for all the globe," he said. "Here you can work for Louisiana, but at the same time you are working for Asia, Africa and billions of people."

Resident coordinator of the H. Rouse Caffey Rice Research Station Kurt Guidry corroborated that the LSU AgCenter is looking toward the future in the release of not only new varieties, but also the technology and models that will be used to create them. Guidry said adding Fritsche-Neto to the researchers at the facility will aid in bolstering the effectiveness of the rice breeding program.

"In addition to the benefits that Dr. Fritsche-Neto's work offers to the rice breeding program, the methodologies, procedures and statistical models developed could also be used to address other aspects of rice production as well as assist other breeding programs within the AgCenter," said Guidry.

While the intricate details of quantitative genetic breeding may be rather complicated, Fritsche-Neto explained, in what may admittedly be an oversimplification, "We try to capture how much of the [traits] like grain-yield variation is driven by genetics or the environment. That is our first goal. Then, after we identify the proportion, we have a couple of tools we can use to increase the genetic factors. Then we can be more confident when we recommend a variety regarding the performance."

In describing his work, Fritsche-Neto uses a 2011 Columbia Pictures pop culture reference to explain quantitative genetics.

"It's like that old movie called 'Moneyball,' but in plant breeding," Fritsche said. "We use statistical analysis to try to identify what is the best player (rice variety) for each position (geographical location), while spending the least [amount of] money as possible."

He said "optimization" is the best word to describe the role of quantitative genetics in plant breeding, but not only can this methodology be used to create new rice varieties, it can also be utilized to better predict a variety's performance after it is created.

Fritsche-Neto earned a bachelor's degree in agronomy from the Federal University of Pelotas, a master's degree in genetics and plant breeding from the University of Sao Paulo, and a Ph.D. in genetics and breeding from the Federal University of Viçosa, all in Brazil. He subsequently served as a visiting scientist at both the University of Minnesota and Cornell University in the U.S. and Queensland University in Australia.

Most recently Fritsche-Neto served as a senior scientist for the International Rice Research Institute (IRRI), in the Philippines. While working remotely for the IRRI, his expertise in quantitative genetics and biometrics propelled him to work in developing new statistical models for plant breeding.

"I had close contact with the breeders," he recalled. "My role in this scenario was to develop new statistical models to support and identify what are the best genotypes for each location."

So how does one improve those tried-and-true rice breeding methods? With quantitative historical data collected, stored and analyzed with the latest in statistical data technology.

"We can bring historical weather data," he said. "We can bring markers, drone-imaging analysis, artificial intelligence models and put all these ingredients in statistical modeling and better understand what the best genotypes are for each location."

The geneticist said, along with the updated technologies, there are three layers of data sets that will be used to make predictions in the rice breeding program: traditional phenotypes; historical environmental data, such as temperature, precipitation and soil; and genotype markers. He also added that he has collected more than 20,000 soil composition samples from locations around the globe over the course of his career.

"That would be the ideal scenario," he said. "If I have these three layers of data, we can apply simple statistical models to the more advanced ones — like artificial intelligence."

He said the extensive data collection that has been compiled at the Rice Research Station was a significant draw for him to join the faculty at the 113-year-old facility.

"I am very happy because before I arrived here, when we started conversations, I knew the breeding program has all the data organized in a database for the last 20 years," he said. "For me, it is vital to rely on these historical data sets."

Looking to the future, the geneticist said his work in creating new breeding schemes and models can have potential benefit that goes beyond the rice industry. Other self-pollinating crops, such as wheat, can be bred using the same models that Fritsche-Neto aims to create during his time with the LSU AgCenter.

Fritsche-Neto, along with wife Liana and daughter Helena, hails from southern Brazil. The family now lives in Lafayette where he said he is excited to embrace his passions of fishing and cooking while living in Acadiana.

Focus: Research Associate Madeline Lejeune

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Madeline Lejeune admits that when she first applied to work at the H. Rouse Caffey Rice Research Station, it was just a summer job. That was seven years ago. Now, as a research associate assisting in the H. Rouse Caffey Rice Research Station Breeding Program, she hopes to make a career out of her time in the genetics marker lab.

Lejeune graduated from Iota High School and proceeded to LSUE, then transferred to McNeese State University, where she graduated in general studies.

When she started working here, she spent the bulk of her time working in the facility's greenhouses in the realm of anther culture. She has since progressed to the genetics marker lab. She says her time in the greenhouses helped her progress to her current position .

"We had to plant a lot of seeds to take leaf samples," she explained. "Knowing how to do that, it's a direct replication of the plates we sample into. So, being able to just transfer that into what we're doing just kinda goes hand-in-hand."

The crux of the research that she assists in conducting revolves around DNA, which is something she said has always piqued her interests.

"For some reason, I have always liked science," she said. "I never really had a background in it. I never had a background in agriculture. But I do like learning new things, especially about all the traits and the varieties. I never knew we had so many."

She says the intricately technical, sometimes tedious, work that she conducts on a daily basis involves the important task of sampling.

"I organize the samples. Then, we make a plan of how we're going to do it and we run the DNA markers test. I also do the seed count."

In her seven years at the Rice Research Station, Lejeune says she has seen a lot of changes in the way research is conducted.

"Everything we used to do was by hand," she said. "You had to physically go out and look at the rice and take notes. Everything was on paper. Now, everything is so much faster with the technology we use. It's easier to do. It's more accurate. You don't have to transfer data."

When listing the state-of-the-art technology she uses in the genetics marker lab, Lejeune sounds like she would be right at home in the medical field. There are machines that dispense the DNA markers. Machines that break apart and replicate the DNA, she listed.

"We use a lot of technology," she said wide-eyed.

A direct impact of those technologies to Louisiana rice farmers comes in the form of a service that the genetics lab provides in helping farmers identify rice varieties. With this service, farmers bring in rice samples that they presume may be of a certain variety. Lejeune and her colleagues test the provided samples to determine if they are indeed what the grower presumes they are, or if there has been some crossing in the environment where it is grown. She described the process that is involved in offering this service.

"If things get mixed up, they need us to test it," she explained. "So, we will test the genetic markers to see if the genes match up with what it is supposed to be so we can tell them, 'Yes, this is exactly what you thought you planted. Or, no, something went wrong.'"

Now, having attained her self-proclaimed "biggest goal" of reaching her research associate status--which she did in January 2021--she is focused on a long career here at the Rice Research Station.

Research Associate Madeline Lejeune has amassed a wealth of rice breeding knowledge in her seven years at the Rice Research Station.