Plastic tubs may hold secrets to producing more rice for the world

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Dr. Lee Tarpley examines some of the 1,700 varieties of rice stored at the Texas A&M AgriLife Research and Extension Center in Beaumont. Credit: Texas A&M AgriLife Research photo by Kathleen Phillips

Dozens of plastic tubs stacked in a room may look ordinary, but they store what could be the secrets to more rice to feed the world.

The containers are the resting place for what's known by scientists as a "core collection," or fraction of all the known varieties of rice on Earth. Yet, even from their plastic vaults housed at the Texas A&M AgriLife Research and Extension Center in Beaumont, these grains are yielding data scientists say will help make better varieties for years to come.

"Beaumont is the only location where the full collection has been grown for the purpose of analyzing the chemical element composition," said Dr. Lee Tarpley, an AgriLife Research plant physiologist, who is using the collection extensively in his studies there.

In all, thousands of rice varieties made their way into the collection by way of numerous scientists, who over decades ventured across North and South America, Europe, Africa, Australia and Asia in search of samples, Tarpley said.

The seeds most recently were used for a massive study to determine which varieties are most capable of using major nutrients, such as phosphorus or potassium, from the soil.

"The lines that are most capable of using key elements, which are valued for either plant or human nutrition, could be potentially used in breeding programs to develop new rice varieties," Tarpley explained.

Because of the importance of the world's diversity of rice for farmers and for human consumption, he teamed with Dr. Shannon Pinson of the U.S. Department of Agriculture in Stuttgart, Arkansas, Dr. David Salt at the University of Aberdeen in Scotland and Dr. Mary Lou Guerinot at Dartmouth College in Hanover, New Hampshire, on a National Science Foundation-funded research project to examine huge numbers of genotypes of rice varieties to find out what elements they contain.

According to the International Rice Research Institute, the commodity is a staple for about 3.5 billion people and is grown on almost 400 million acres worldwide. U.S. farmers raise the crop on about 3 million acres, according to the U.S. Department of Agriculture's Economic Research Service.

Over a period of five years, the 1,700 varieties were grown in the fields around the Beaumont center, carefully harvested and tagged, then sent to the University of Aberdeen where Salt has a system for measuring 17 different elements simultaneously, Tarpley said.

"We measured both leaf and grain so that when we saw differences in the grain, we could start to understand their physiological basis," Tarpley said. "We could question, 'Is that something that shows up as a difference in the leaf and therefore might actually be a difference in uptake of the roots changing the level throughout the plant?' or 'Is it something that gets sequestered in the leaves that's never going to make it to the grain?'"

The team found some surprising differences in leaf levels of these various minerals, he said, indicating that some types were taking up higher levels of these elements compared to an average rice variety.

"What we found for most of the elements is that there are a few extreme lines that are very good at taking up or have very high levels of one or more of the elements," he said. "And, it's easier to find the ones that take up higher amounts than it is low amounts."

The team already has started making crosses with the high accumulating lines and a normal accumulating line. The next step is to screen and evaluate the progeny to determine the kind of inheritance that resulted.

"We are working towards identifying possible regions of the chromosomes that might have the genes involved in the results of the progeny," he said. "The main goal of the overall research project was gene identification—to take advantage of our knowledge of the rice genome to identify the functions of all the genes. But ultimately that's for the purpose of more precise breeding of plants.

"Take phosphorus, for example, which can be limited in various soil types in Texas," Tarpley noted. "If we had a line that was better at grabbing the phosphorus that is in the soil, that could potentially save some money in terms of not having to apply phosphorus fertilizer. It could be that we would want a good soil uptake in all the rice we grow, so that it would be more robust for different growing conditions.

"The research provides the potential to allow decreased fertilizer use and increased sustainability in Texas rice production," he said.

Tarpley noted that the extensive data obtained may allow scientists now to do numerous studies without having to grow the 1,700 varieties in the field again.

"We are finding some patterns in the grain and leaf material, for example, which seem to indicate different elements are more common in rice varieties from the same part of the world," he said. "Elements such as molybdenum or cobalt have shown up more in some areas than others. It's a lot of fun to try and understand why they might've had that adaptation."

Provided by Texas A&M University

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