

Arkansas Rice Breeders Join 5-State Consortium To Develop Hybrids

STUTTGART, ARK.

The University of Arkansas Division of Agriculture is partnering with four other land-grant universities to develop hybrid rice varieties. Universities joining Arkansas in the hybrid breeding consortium are Louisiana State, Texas A&M, Southeast Missouri State and Mississippi State.

Chris Deren and Zongbu Yan, who developed eight hybrid rice varieties in China before moving to Arkansas in 2008, are conducting the hybrid program at the Division of Agriculture's Rice Research and Extension Center near here. Deren is a rice breeder and professor of crop, soil and environmental sciences who served as RREC director from 2000-2010.

Another member of the team is Wengui Yan, a research geneticist at the USDA Dale Bumpers National Rice Research Center, next door to the RREC. He leads the Rice Germplasm Evaluation and Enhancement team at the USDA center.

RiceTec, Inc., in Alvin, Texas, is currently the only source of hybrid rice seed in the United

program the following spring.

"We are extremely lucky to have Professor Yan," Deren said. "He jump-started our program with his experience as a very successful hybrid breeder in China and the work he did at UAPB and here on his own."

"Successful development of a hybrid is a numbers game," Deren said. "It requires thousands of crosses and backcrosses to obtain a hybrid with economically competitive genetic traits."

Yan produced 110 experimental hybrid lines in 2010 and will have 100 more this year. F1 (first generation) seed of each hybrid line is planted and the resulting plants are screened for desired traits. "That is a strong start, but we have many miles to go," Deren said.

Yan said the main advantage of hybrid seed is "hybrid vigor," which causes certain traits of each parent to be magnified in the F1, or first generation, hybrid. An F1 hybrid will typically yield significantly more grain than either parent line, but other traits may be inferior.

Yan and Deren are using both a "two-line" hy-



The University of Arkansas Division of Agriculture's new hybrid rice breeding program is based at the Rice Research and Extension Center near Stuttgart. Pictured at a field day in August 2010 are Division of Agriculture breeders, from right, Zongbu Yan and Chris Deren, with Wengui Yan, left, a research geneticist at the USDA Dale Bumpers National Rice Research Center. An experimental hybrid (foreground, center) is from a cross of a plant of the Francis variety, left, and a male-sterile line. Within the plastic curtains, 110 experimental hybrids were being tested for seed production.

States, and growers would like to have others from which to choose, Deren said.

Hybrids account for a large percentage of rice grown in Arkansas, but most growers still plant self-pollinated varieties from the university's conventional breeding program based at the Stuttgart center. The state's rice farmers support the program with annual grants from the Arkansas Rice Research and Promotion Board (ARRPB). In return, they get public varieties well-adapted to Arkansas conditions.

Hybrids may produce higher yield and have other special traits, but seed of public, self-pollinated varieties is typically a fraction of the price of hybrid seed, Deren said.

The state's farmers are also supporting the new hybrid breeding program through the ARRPB. Staff, facilities and equipment are provided by the Division of Agriculture.

Deren said it will likely be a decade or more before competitive hybrids are released from the five-state consortium of public hybrid breeding programs.

Breeders of self-pollinated rice varieties usually require ten years or more to release an improved variety from the initial cross of two parent lines, if all goes well, Deren said. Developing a hybrid is much more complex and time consuming.

The Arkansas effort began with the appointment of Zongbu Yan to the new hybrid breeding program in April 2010. Yan retired in 2008 as a professor and rice breeder at the Rice Research Institute of Guizhou Province in China. Before joining the Division of Agriculture staff, he was a visiting scientist in the School of Agriculture, Fisheries and Human Sciences at the University of Arkansas in Pine Bluff.

Yan was already known to several Arkansas rice farmers and scientists through his interaction with the Division of Agriculture here and in China. His son, Jun Yan, has a degree in electrical engineering from the University of Arkansas.

In July 2008, Yan visited with Chris Isbell, an England, Ark., rice farmer, who urged him to pursue development of hybrid rice for Arkansas producers. In August, Yan began working on developing a hybrid line "just for my own interest" in a greenhouse at UAPB and at USDA facilities of Wengui Yan at Stuttgart. Deren, who was RREC director at the time, hired him in August 2009 in anticipation of starting a hybrid

brid system and a "three line" system, and will eventually focus on the approach that shows the most promise, Deren said. Both systems require specialized breeding lines that possess rare genes for traits such as male sterility or the opposite, restoration of fertility.

Wengui Yan and his staff assist Zongbu in selecting and screening exotic lines from the USDA's world germplasm collection that may possess the various rare genes needed to make a hybrid. One promising male sterile line was found in this way, and others have been created by crossing selected plants from very diverse genetic backgrounds and observing the progeny, Deren said.

"It is important to remember that the sources of these genes are what we may often dismiss as 'junk lines,' because they are so unsuitable for commercial production," Deren said. "Many years of cross-breeding and careful selection are needed to get these genes required to make a hybrid into a line that will have the yield, quality, disease resistance and other traits we must have."

The three-line system requires male-sterile, maintainer and restorer lines, and Yan has already developed several of each at RREC.

Male-sterile lines do not produce pollen but can accept pollen from other plants.

The maintainer line is used to produce seed of the male-sterile line. It is genetically identical to its male sterile counterpart except for being male fertile. It can pollinate the male sterile and thus provide for a continuous supply of male-sterile lines with identical genetic traits.

The restorer line, which restores fertility in the F1 hybrid when crossed with a male-sterile line, is used to pollinate the male-sterile parent and produce hybrid rice seed.

In the two-line system, one has "environment-sensitive genetic male sterility." The line is male-sterile when grown under normal conditions, but it regains fertility when grown under different day-length or temperature conditions. Thus, it does not require a maintainer line, and most fertile lines can be used as a pollen parent to produce an F1 hybrid.

"This is an exciting challenge with future long-term benefits for our rice industry," Deren said. "The cooperation and friendly competition among the five breeding programs in the consortium will be a great advantage." Δ

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