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RICE RESEARCH STATION NEWS
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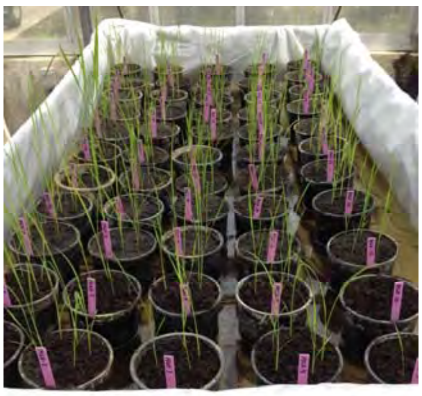
# Hybrid Rice Breeding Program Update



**Hybrid germplasm in greenhouse.**

Hybrid rice, which is produced from the first generation ($F_1$) of seeds between a cross of two genetically dissimilar pure line (inbred) parents, represents an option for Louisiana farmers to the standard commercial inbred varieties. Commercial hybrids typically yield 10 percent to 20 percent more than the best inbreds grown under similar conditions, believed to be the result of hybrid vigor or heterosis from crossing the two parents. Research goals of the hybrid rice program at the Rice Research Station include: 1) developing male sterile lines (cytoplasmic A or environmental sensitive S), restorer (R) and maintainer (B) lines adapted to the southern U.S. environmental conditions; 2) identifying elite cross combinations through extensive test-crossing; and 3) developing an economical hybrid seed production system for Louisiana.

Agronomic and milling data from the 2014 Advanced Hybrid Yield Trials highlighted five hybrids – 08A/12XB4, LAH10, LAH169, LAH25 and LAH28 – with high yield potential and good milling performance across three locations in Louisiana versus the check XL723. The early-maturing, conventional long-grain LAH169 exhibited good yield potential and good grain appearance and uniformity with low endosperm chalk values.

The 2014 Observational (Testcross) Trial evaluated new hybrid combinations for high grain yield, good milling performance, height, maturity, lodging percentage, and other agronomic characteristics. A total of 49 three-line and 21 two-line hybrids produced at least 10 percent higher yields than the inbred check CL111. Thirty-five hybrid selections produced greater yields than the commercial checks XL723 and CLXL729. Head rice yield for various selected hybrids was similar to that of the check CL152. From all testcross material, five were identified with low chalk values similar to those of CL152 and CL111.

To complement the existing Clearfield herbicide technology, the Rice Research Station is developing inbred and hybrid varieties resistant to the quizalofop-p-butyl herbicide for control of grass weeds. Inheritance studies indicate that resistance to quizalofop-p-butyl at the 2X field rate (30.1 oz/A) is controlled by a single, dominant gene that acts in a predictable Mendelian fashion. Reciprocal crosses indicate that maternal factors had no impact on the segregation or level of resistance to quizalofop-p-butyl.

Synchrony of flowering between parents is crucial for high hybrid rice seed yields. A BASF seed treatment compound was evaluated for delay of germination for 11 Louisiana inbred varieties and lines in a 2014 replicated trial at the Rice Research Station. Low rates of the compound were ineffective in delay of germination. However, higher concentrations delayed heading date seven to nine days for some varieties.

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**Hybrid testcross populations.**

## Special Dates of Interest:

- **LARC/LARGA Annual Joint Meeting**
  **Tuesday, February 10, 2015, 4p.m.**
  **Grand Marais Center, Jennings, LA**
- **NE LA Rice Forum**
  **Thursday, February 12, 2015 , 8:30 a.m.**
  **Delhi Civic Center, Delhi, LA**
- **Rice Research Station Field Day**
  **Wednesday, July 1, 2015**
  **Crowley, LA**

## Inside this Issue

# Pest of the Quarter - Seedling Blight of Rice


Figure 1

Seedling blight, or damping off, is a disease complex caused by several seed-borne and soil-borne fungi, including species of *Cochiobolus*, *Curvularia*, *Fusarium*, *Rhizoctonia* and *Sclerotium*. Typically, the rice seedlings are weakened or killed by the fungi (Figure 1). Environmental conditions are important in disease development. Cold, wet weather is most favorable to disease development.

Seedling blight causes stands of rice to be spotty, irregular and thin. Fungi enter the young seedlings and either kill or injure them. Blighted seedlings that emerge from the soil die soon after emergence. Those that survive generally lack vigor, are yellow or pale green and do not compete well with healthy seedlings.

Severity and incidence of seedling blight depend on three factors: (1) percentage of the seed infested by seed-borne fungi, (2) soil temperature and (3) soil moisture content. Seedling blight is more severe on rice that has been seeded early when the soil is usually cold and damp. The disadvantages of early seeding can be partially overcome by seeding at a shallow depth. Conditions that tend to delay seedling emergence favor seedling blight. Some blight fungi that affect rice seedlings at the time of germination can be reduced by treating the seed with fungicides.

Seeds that carry blight fungi frequently have spotted or discolored hulls, but seed can be infected and still appear to be clean. *Cochiobolus miyabeanus*, one of the chief causes of seedling blight, is seed-borne. A seedling attacked by this fungus has dark areas on the basal parts of the first leaf.

The soil-borne seedling blight fungus, *Sclerotium rolfsii*, kills or severely injures large numbers of rice seedlings after they emerge when the weather at emergence is humid and warm. A cottony white mold develops on the lower parts of affected plants. This type of blight can be controlled by flooding immediately.

Treatment of the seed with a fungicide is recommended to improve or ensure stands. Proper cultural methods for rice production, such as proper plant-ing date or shallow seeding of early-planted rice, will reduce the damage from seedling blight fungi.

Water-borne and soil-borne fungi in the genus *Pythium* attack and kill seedlings from germination to about the three-leaf stage of growth. Infected roots are discolored brown or black, and the shoot suddenly dies and turns straw-colored. This disease is most common in water-seeded rice, and the injury is often more visible after the field is drained. It may also occur in drill-seeded rice during prolonged wet, rainy periods.

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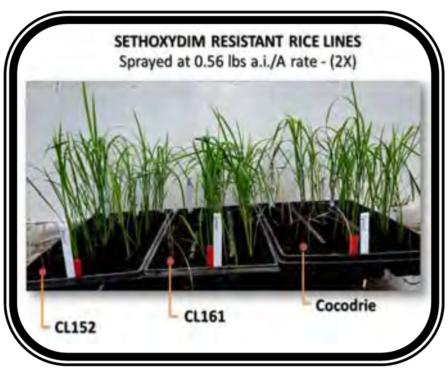
# Masker-Assisted Breeding




Marker-assisted selection is a routine procedure at the Rice Research Station as a direct way of selecting important genes at the DNA level prior to the trait expression at the phenotypic level to alleviate possible confounding environmental effects. The Marker-Assisted Breeding lab focuses on four major goals: 1) improving rice grain quality by applying molecular selections to enhance multiple important grain quality components simultaneously, 2) mapping grain chalkiness, 3) identifying QTL coding regions and developing unique identification for high lysine and high grain protein content, and 4) identifying sequence specificity in the gene region coding for Acetyl CoA Carboxylase (ACCase) that gives rise to sethoxydim herbicide-resistant rice lines.

Improving and maintaining rice grain quality are important in developing varieties. Amylose content, gelatinization temperature, eating quality, aroma, and grain elongation are important chemical and physical properties associated with rice grain quality. Physical appearance, such as chalkiness, translucency, grain size and dimension, and homogeneity of the grain, is another important aspect of grain quality. Yearly, marker-assisted breeding evaluated 8,000 headrows of various breeding lines developed to accommodate the breeding goals. Advanced lines are tested in the multilocation trials in collaboration with Dr. Steve Linscombe in Evangeline, Vermilion, and Jefferson Davis parishes and the Rice Research Station near Crowley. Several promising lines are identified.

Chalkiness does not only affect physical appearance of the grain but also milling and cooking quality. Efforts are being made to map the trait using Southern U.S. lines. Markers identified will be very useful and can be incorporated into the overall effort to improve grain quality, including grain elongation, translucency, and grain size homogeneity.

Intensive mapping on previously identified QTL regions coding for high grain protein content has resulted in specific identification in the regions consistent with several high protein rice protein lines producing 11 percent or more of protein content. Efforts are also being made to identify unique sequence inside the gene coding for DHDPS (dihydrodipicolinate synthase) that contributes to the elevated level of protein content. This additional information will add to specificity that is not only important for a definitive molecular identification but also for use in the breeding of high protein rice.

New rice lines resistant to sethoxydim herbicide have been identified through induced mutation. Sethoxydim is a post-emergence gramicide that controls annual and perennial grasses. It has a different mode of action from imidazolinone herbicides used in the Clearfield system. Sethoxydim herbicide will kill conventional rice, red rice, Clearfield rice, and Clearfield-resistant red rice. This new rice line can tolerate up to twice the concentration of the normal rate of sethoxydim herbicide (0.56 lb a.i./A). This sethoxydim-resistant line will complement Clearfield rice. Further studies are being carried out to investigate resistant characteristics at enzymatic and molecular levels. Marker evaluation is being focused on the gene coding for Acetyl CoA Carboxylase, a critical enzyme catalyzing the first committed step in fatty acid synthesis and the main target of sethoxydim.

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# Breeding for Resistance to Bacterial Panicle Blight

Bacterial panicle blight, which is caused by the bacterial pathogens *Burkholderia glumae* and *B. gladioli*, is a major rice disease in Louisiana and other rice-producing states in the southeastern United States. The other two major diseases in this region are blast, caused by the fungal pathogen *Magnaporthe grisea*, and sheath blight, caused by the fungal pathogen *Rhizoctonia solani*. Serious yield reductions from bacterial panicle blight have also been reported in the rice-growing countries of Central and South America, such as Panama and Columbia. Typical symptoms of bacterial panicle blight include inhibition of seed germination, rotting of seedlings and sheath, and blighting of panicles causing empty grains (Figure 1). These symptoms are mainly caused by "toxoflavin," the plant toxin produced by the bacterial pathogens.


Figure 1. A typical symptom of bacterial panicle blight.

Unfortunately, there are few effective control measures available for this important disease. Fungicides are not working for bacterial pathogens, and most antibiotics cannot be used for controlling plant diseases. Oxolinic acid (Starner), the only available chemical agent for bacterial panicle blight so far, is not registered in the United States. Thus, disease management of bacterial panicle blight should largely rely on growing disease-resistant rice. However, most of the rice varieties having high commercial values are susceptible to bacterial panicle blight, and reliable genetic sources of disease resistance are rarely available.

Continuous efforts to develop new rice varieties resistant to bacterial panicle blight have been made by LSU AgCenter rice breeders and pathologists. Jupiter (a medium-grain variety) and LM-1 (a mutant line derived from the long-grain variety, Lemont) are among the rice varieties/lines showing partial disease resistance to bacterial panicle blight developed by the Rice Research Station. Currently, we are trying to generate more rice germplasm having higher levels of disease resistance to bacterial panicle blight. The rice line LB-33 is a good example of the promising lines generated from our breeding program for disease-resistant rice. This rice line is a progeny derived from the cross between LM-1 and Bengal, which is a disease-susceptible medium-grain variety, and shows a higher level of disease resistance to bacterial panicle blight as well as sheath blight compared with its disease-resistant parent, LM-1 (Figure 2). Moreover, LB-33 shows a high yield potential, indicating that this rice line can be an excellent breeding material to improve agronomic traits of existing commercial varieties.

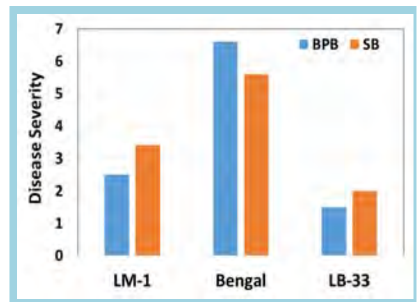

Figure 2. High levels of partial disease resistance of LB-33 to bacterial panicle blight (BPB) and sheath blight (SB) compared to its parental lines, LM-1 and Bengal.

Currently, several different approaches are being made simultaneously to generate new disease-resistant rice for bacterial panicle blight. First, the genetic elements determining the disease-resistant traits of disease-resistant rice varieties/lines – such as Jupiter, LM-1 and LB-33 – are incorporated into commercially valuable but disease-sensitive varieties through conventional hybridization procedures. Second, rice germplasms obtained from various collections are tested to select rice lines showing high levels of disease resistance to bacterial panicle blight (Figure 3). Third, random mutant lines generated by artificial mutagenesis of a disease-susceptible commercial variety (e.g. Mermentau) are screened to select mutant lines showing enhanced disease resistance compared to their parental variety (Figure 4). Tissue culture techniques for culturing somatic and reproductive cells of rice are also applied to generate more rice germplasms to be screened for increased disease resistance.

Conclusively, our breeding efforts described here will make gradual improvements of disease resistance to bacterial panicle blight in commercial rice varieties, even though this is a challenging and long-term task.


Figure 3. Rice germplasms tested for disease resistance to bacterial panicle blight and sheath blight.

Figure 4. The rice field plot growing mutant lines of the disease-susceptible variety, Mermentau.

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# New RRS Capabilities in Cereal Chemistry Analysis

Grain quality is a high priority for the LSU AgCenter and other university rice breeding programs, although yield is also an important part of the equation. A set of new laboratory equipment has been added at the Rice Research Station that enables a quick analysis of breeding lines being reviewed for development. This equipment will improve the workflow in the variety development program; it runs cereal chemistry analyses to determine amylose content as well as the viscosity of the rice flour. This work had been sent to a lab run by the U.S. Department of Agriculture.

Amylose is a starch that determines whether rice grains are firm or sticky. Low-amylose rice, such as short-grain, is stickier, while most long-grains have an intermediate level of amylose, making the grains firmer. The amylose content of most medium-grains is between short-grain and long-grain.

To test for amylose content, a small amount of rice, about 1 gram is ground, and about 50 milligrams of it is mixed in a solution that is sampled and analyzed through the new specialized equipment (Figure 1).

A robotic machine extracts about 1 milliliter for a sample that is pumped through a machine, separated by a small bubble of air. The amylose content is measured in each sample with the use of infrared light, and the results are downloaded to a computer. This machine can analyze as many as 120 samples every two hours (Figure 2).

As part of grain quality measure, gelatinization temperature analysis is also conducted in this laboratory. Gelatinization temperature testing determines how long rice has to be cooked. The grains being tested are soaked in chemicals that can cause the grains to swell and spread. Grains that swell spreading more in the solution are ranked higher on a 7-point scale that is correlated to a cooking temperature scale. It takes 24 hours to get the results for gelatinization temperature, and this lab has the capability of analyzing 150 samples per day (Figure 3).

Another machine determines the viscosity, or thickness, of a solution made with rice flour. This test is important to food companies that use rice flour as an ingredient in their products.

The quick results from the testing for amylose content, gelatinization temperature and rice flour viscosity make it possible for rice breeders at the Rice Research Station to make an early decision on what lines they want to advance.

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Figure 1.

Figure 2.

Figure 3.

Photos by Bruce Schultz

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Focus

# Rita “Diane” Schneider

Diane Schneider is retiring as regional administrative coordinator after working 22 years for the LSU AgCenter.

She started part-time in 1993 in the Jefferson Davis Parish Extension Office after working for an oil company. In 1996, she began working full-time for Regional Director Bill Davis and later moved to what is now the Rice Research Station-Southwest Region Office.

She said she will miss her job and especially her fellow employees.

“I enjoy the job, and the people here are very nice,” she said.

Diane said the office staff has become like a family. “Everyone is easy to get along with. If someone has a big deadline, we all pitch in.”

She said entering retirement is not something she took lightly. “It was a big decision. It’s time for someone younger to come in.”

Taking her place is Estelle Trahan, who’s been on the job a month, working alongside Diane to learn the job.

Diane has worked closely with the 14 parishes and two research stations in the Southwest Region. She helps county agents with maintaining records and paperwork, keeping tabs on payroll, inventory, travel and accounting.

She worked closely with Lanette Hebert, regional 4-H coordinator.

“She is a blessing to me and our organization. She has a strong work ethic and dedication. And she is a caring individual who is always genuinely concerned about doing the best she can in representing the LSU AgCenter,” Hebert said.

Her job also required her to work at the station with Russell Dilly for the safety program of the Rice Research Station and the Southwest Region. Dilly said Diane’s work has helped him considerably.

“Diane has been an extremely valuable asset to the Rice Station and Southwest Region Safety Program. Her diligence and attention to detail has been invaluable to me as the program administrator.”

Diane said computerization has been the biggest change since she started her LSU AgCenter career.

“Everything is all electronic,” she said. “It’s much better. Scanning is a lifesaver for documents.”

With seven grandchildren and one great-grandchild, ages 2 to 22, she will have plenty to keep her busy. Her three sons – Travis, Chad and Gregg – and daughter, Anne, live near her, along with five sisters and a brother. “We are very much family-oriented.”

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