H. Rouse Caffey
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Sulfur Fertilization for Rice Production

Sulfur is an important plant essential nutrient needed for rice growth and development. Sulfur is a component of many plant enzymes and proteins. A soil test is a very good tool to determine if sulfur is limiting in your soil and if you need to apply sulfur fertilizer to maximize rice yields. Currently, the LSU AgCenter uses the Mehlich-3 soil test extraction to estimate how much sulfur is available in the soil and how much sulfur fertilizer will need to be applied to maximize yield. The sulfur soil test table can be found in the Rice Varieties and Management Tips publication and can be used to generate fertilizer recommendations from any soil testing laboratory using the Mehlich-3 soil test. In general, if the soil test results indicate that the soil is low or medium in sulfur then 40 or 20 pounds of sulfur is recommended, respectively.

Elemental sulfur fertilizer (0-0-0-90S).

Sulfur must be in the sulfate form (SO_4^{-2}) to be utilized by plants. Ammonium sulfate, zinc sulfate, and other sulfate fertilizers are excellent sources of sulfur. However, elemental sulfur (S_2) fertilizer (commonly 0-0-0-90 S) is not a good fertilizer source to use *in-season* for rice because the sulfur is not in an immediately available form. Elemental sulfur must be converted to the sulfate form before it can be taken up by rice roots. This conversion is called sulfur oxidation and it is done by sulfur oxidizing bacteria. Oxygen is required to make the conversion. Once rice is flooded, generally, very little elemental sulfur will be converted into sulfate sulfur due to the lack of oxygen.

In upland conditions, elemental sulfur oxidation to sulfate sulfur is a very slow process. The conversion can be influenced by several factors, including the size of the fertilizer (powdered will be oxidized faster than pastilles), temperature, soil type, soil pH, soil water content, oxygen availability, and the amount of sulfur oxidizing bacteria in the soil. Elemental sulfur fertilizers are often made into pastilles (see picture) which contain a small amount of clay added to enhance dispersion and speed oxidation. Nonetheless, even in upland conditions, elemental sulfur pastilles will still be slow to oxidize. For example, one study illustrated that for a fertilizer size similar to the one in the picture, only 2% of the elemental sulfur would be converted in one month. Therefore, applications of elemental sulfur for rice *in-season* for a soil that is deficient in sulfur is not recommended. Applications of elemental sulfur are recommended in the fall and winter to bring soil test sulfur levels up and also to help lower soil pH.

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Inside this Issue

Special Dates of Interest:

- **Rice Technical Working Meeting, Long Beach, CA February 19-22, 2018**
- **H. Rouse Caffey Rice Research Station Annual Field Day June 27, 2018**

Rice Market Outlook – Jan. 22

Tight rice supplies have provided support for prices, however, declining export projections offer little support for the long-term price outlook. Attention will now shift to planting intentions.

The projected 2017-18 rice crop yield was lowered to 178.2 million hundredweight (cwt) in the latest U.S. Department of Agriculture report; a decrease of more than 20% from the previous year's yield. For the second consecutive month, the projected rice crop yield estimate was lowered due to a downward revision in area. At 2.37 million acres, harvested area is 17,000 acres below the previous estimate and 23% below the year prior. If realized, this would be the smallest harvested area for rice since 1987-88. Harvested area in 2017-18 was lower in all six rice-producing states, with Arkansas reporting more than half of the 723,000-acre decline. At 1.1 million acres, rice harvested in Arkansas is 27% below a year earlier and the smallest in four years. Lower long-grain prices at planting and severe flooding early in the planting season accounted for a majority of the decline in rice area.

From a supply-side perspective, beginning stocks remain at an estimated 46 million cwt. Long-grain beginning stocks are estimated at 31 million cwt, 37% above a year earlier and the highest since 2011-12. In contrast, medium and short grain beginning stocks of 11.5 million cwt are 45% below a year earlier and the lowest level since 2009-10. The import forecast was raised 6% based on reported shipments of jasmine and basmati rice through November from Thailand and India. Thailand has accounted for over half of the increase in rice imports. Total rice supply is projected at 249.3 million cwt, 15% below a year earlier and the smallest since 2003/04. Long-grain supplies are projected to decline 14% as a result of a smaller crop. Medium- and short-grain supplies are projected to be 20% less than a year ago, due to smaller carry-in and a reduced crop.

On the use-component of the rice balance sheet, total rice exports in 2017-18 are projected at 100 million cwt, 14% below a year ago. Through Jan. 4, 2018, U.S. shipments and sales to the Western Hemisphere, the largest market for long-grain rice, were less than the previous year. By class, the long-grain export forecast was lowered to 71 million cwt, 10% below last year. The U.S. faces strong competition from Asian exporters in the Middle East and Africa, with South American exporters also shipping into these regions. The decline is based on smaller U.S. supplies, higher prices, and larger exports from Australia and China. Medium- and short-grain exports are projected at 29 million cwt, 24% below a year ago. U.S. sales outside the core markets of Japan, Korea, and Taiwan (made as part of World Trade Organization-agreements) have been extremely small, with the current forecast for fewer sales outside of northeast Asia and Canada. China, Egypt, and Australia are the major competitors in the global medium- and short-grain market. However, Egypt's rice exports continue to be constrained by government export restrictions.

By type, rough rice sales are 20% below a year earlier. Sales to North Africa and the Middle East have been very small. Rough rice sales to Venezuela, the top long-grain buyer have fallen below last year's pace. Milled rice export sales remain 11% below a year ago. The decline in milled rice exports is based on smaller supplies, higher U.S. prices, and more global competition in several market outlets, particularly Sub-Saharan Africa and the Middle East.

Considering the supply and use dynamics, ending stocks are lowered to 29.2 million, 37% below a year ago, and the smallest since 2003-04. The stocks-to-use ratio is estimated at 13.3%. By class, long-grain ending stocks were lowered to 16.4 million cwt, 47% below last year. Medium and short grain ending stocks were also lowered to 9.3 million cwt, down 19% from a year earlier.

This month, the USDA lowered its season average farm price for long-grain rice to $11.30 to $12.30 (midpoint of $11.70) per cwt. The southern medium grain farm price was also lowered to $11.50 to $12.50 (midpoint of $12) per cwt. In late December, long-grain monthly cash sales for the month of November were reported at $11.50 per cwt, an increase of 30 cents per cwt from October reported cash sales.

Rice plantings in 2018 will largely determine the market outlook for rice. USDA reports a 17% projected increase in the year-over-year rice plantings. Particularly, plantings in the state of Arkansas will have the largest impact on the market outlook. Attention will be on the price attractiveness of alternative crops, namely soybeans in the region. The January USDA price estimate for soybeans rests at $9.30 per bushel. History suggests that plantings in Arkansas will likely increase, following a year with suppressed acreage. Another factor for the long-term price outlook will be demand (e.g. exports). Any gains that can be sustained in the export market will act to encourage an upward movement in prices.

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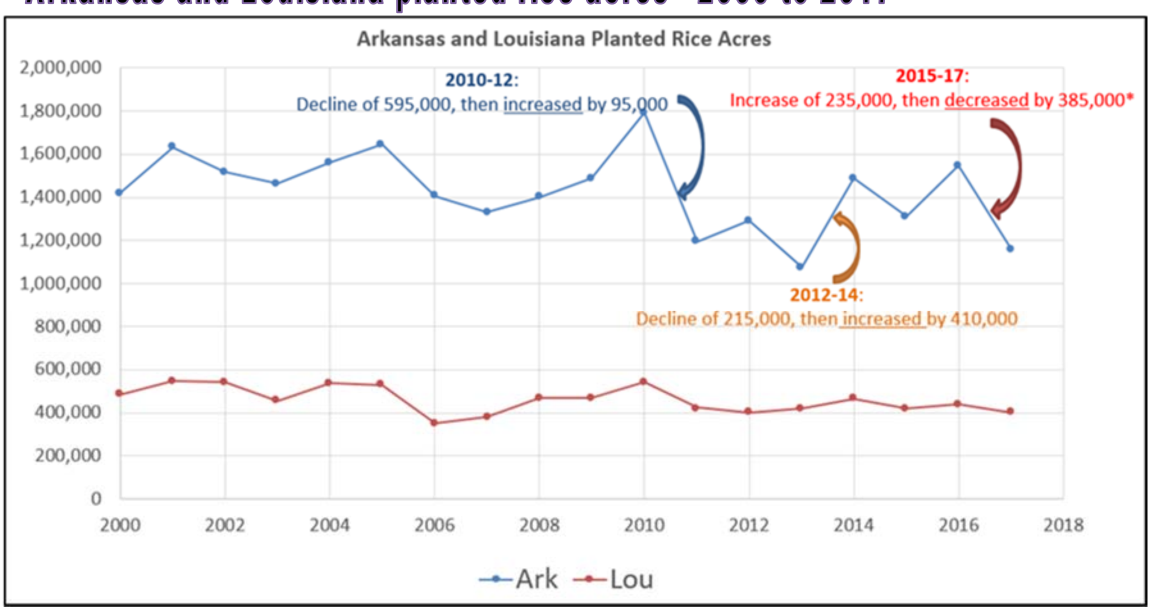
Arkansas and Louisiana planted rice acres - 2000 to 2017



Spring Insect Outlook: How Do Hard Freezes Affect Pests?

Many people are looking for the silver lining from the recent cold spells. One potential upside is that hard freezes can often reduce insect pest populations the following spring. Back-to-back cold snaps were experienced the first few weeks of January with temperatures reaching record lows of 14–17°F in southwest Louisiana, and approaching the single digits in the northeast rice producing regions of the state. These abnormal conditions are certainly capable of affecting the survival of insects over the winter. While it is a general rule that insects don't thrive in cold conditions, some pests handle freezes better than others. Many pests which are native to the U.S. have overwintering strategies which allow them to avoid the coldest temperatures, while tropical invaders are more vulnerable. Here, we will examine some of the winners and losers among rice pests and discuss how this may affect your management plans.

The most damaging insect pest of rice in Louisiana is the rice water weevil, *Lissorhoptrus oryzophilus*. Unfortunately, the cold temperatures in January will likely do little to reduce weevil populations. This pest is native to the U.S. and is known to survive the winters in rice-producing areas of northern Arkansas and southern Missouri where winter temperatures often dip below zero.

Weevils survive by huddling near the ground under leaf litter in wooded areas or by borrowing into clumps of bunch grass adjacent to rice fields. Once they are sheltered, weevils drastically slow their metabolism and survive through the winter on fat reserves built in the late summer and fall. In late March and early April, adults emerge from their winter hiding places and begin feeding on young rice plants. Because the offspring of the overwintering generation directly infest rice in the early spring, even minimal reductions in weevil survival would be of some benefit to rice farmers, although it won't likely be easy to notice. Persistent cold temperatures in February and March can push back the date of the weevils' spring emergence which would be beneficial to rice producers. However, if weather conditions delay planting, that benefit will be largely nullified.

Similarly, the rice stink bug (*Oebalus pugnax*) is a native pest which can survive the winters of more northern rice-producing regions by seeking shelter from the cold. Stink bugs have the added benefit of producing the first spring generation from feeding on weedy grasses, including vaseygrass and barnyardgrass. As a result, there are usually plenty of hungry stink bugs around just in time for rice to begin heading, regardless of winter temperatures.

Typical field in Louisiana after back-to-back cold snaps in the first few weeks of January.

The fall armyworm, *Spodoptera frugiperda*, is another native pest found throughout the U.S. rice-producing regions which isn't greatly affected by winter freezes. This pest flies south for the winter. Populations survive the winter in southern Texas, southern Florida, and the Caribbean, then migrate north in the spring. Armyworms can sometimes survive mild winters in coastal Louisiana but that certainly isn't the case for 2018. More typically, armyworms reach Louisiana in the greatest numbers in early May which won't likely change as a result of the freezes.

Luckily, there are some pests of rice which aren't quite as successful at surviving the cold. Stem borers including the sugarcane borer (*Diatraea saccharalis*) and the Mexican rice borer (*Eoreuma loftini*) are native to tropical regions and are considered introduced species in Louisiana. The Mexican rice borer is not known to occur north of Alexandria. The sugarcane borer is present in northeastern Louisiana but is not a major pest of rice there in most years. These stem borers spend the winter as larvae within the stems of weedy grasses and rice stubble. This provides some protection from cold temperatures, but survival is for several hours. Populations may have recovered by mid- to late-summer, but earlier planted rice should avoid severe stem borer infestations this year. Reduced stem borer pest pressure allows for more flexibility in selection of insecticidal seed treatments, and growers are encouraged to consider all options prior to planting.

The South American rice miner (*Hydrellia wirthi*) is another invasive pest from the tropics which has been problematic in recent years. The pest is most troublesome in coastal parishes, and only low populations have been documented further north, indicating this species is not fond of the cold. Overwintering behavior of the South American rice miner is not well understood, but it is likely that the cold weather has reduced the potential for damaging infestations of this pest this spring.

Farmers who also grow soybeans will see the most benefit of cold temperatures. Populations of the redbanded stink bug (*Piezodorus guildinii*) are anticipated to be greatly reduced in 2018 as a result of the cold.

Although 2018 won't be the pest-free season some are hoping for, we should catch a few breaks this year. Benefits of reduced pest populations will be greatest to early-planted rice, and planting as early as conditions will allow is always encouraged.

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Characterization of Blast Resistance Spectrum

Using SNP DNA Markers

Blast is a major disease of rice in Louisiana, and significant research efforts at the H. Rouse Caffey Rice Research Station (RRS) are focused on developing best management practices and breeding new varieties with blast resistance. As part of the 2018 Rice Varieties and Management Tips Table 8, additional information has been included for each variety's blast resistance spectrum, based on which blast genes are present in each variety. A portion of this table is displayed below. The objective of this information is to provide additional information to use in conjunction with the blast phenotype ratings generated in Dr. Don Groth's disease nursery.

Widespread research activities within the U.S. have provided a better understanding of the basic mechanisms by which blast infects plants. Dozens of blast-resistant genes have been identified in rice, and these genes often have different capacities for conferring resistance to different races of blast. Similar to strains of the flu, there are many different races of blast. One blast resistance gene may confer resistance to some races but not to others. Thus, having a clear understanding of what races of blast are present in Louisiana and which blast resistance genes a breeding line contains can help us predict whether a line will be resistance or susceptible, as well as allow us to determine how robust the resistance may be over locations and years as the races of blast shift.

Researchers at the U.S. Department of Agriculture – Arkansas Research Station have led research efforts to understand the prevalent blast races. This work was initially conducted by Dr. Tony Marchetti in the 1980s-90s and more recently by Dr. Yulin Jia. Recently, Dr. Jia's research group published a research paper that examined blast races collected over the last 60 years across the southern rice growing states, including over 100 samples collected in Louisiana by Dr. Groth. This analysis showed that the predominant races of blast in the south are similar across states, but the presence of a given race may be at different frequencies across states and between years. These research efforts have demonstrated that there are currently eight common races of blast in Louisiana, with the most common including IB1, IB17, IB49, IC17, and IE1.

In conjunction with efforts to understand the races of blast present, Dr. Jia's research group has also tested many of the reported blast resistance genes to determine their effectiveness to each of the individual blast races commonly present in the southern U.S. (Figure 1).

Figure 1 summarizes the resistance of different blast resistance genes across the different races of blast commonly observed in Louisiana. The most common blast races are in bold to highlight their importance. The genes that are shaded in green (Pita, Pib, Piz, Pikh/Pikm) are already present in some released U.S. varieties. The Pita gene confers resistance to all the races, except IE1K, thus we consider lines containing Pita to have a broad spectrum resistance. This gene has only been present in two Louisiana varieties, Catahoula (released in 2008) and in the recently released Clearfield long grain CL153.

The gene Piz is the main blast resistant gene in our medium-grain germplasm, some medium-grain varieties that have contained Piz include Bengal, Neptune, CL271, and the recently released CL272. The commonly grown medium-grain variety, Jupiter, does not contain this gene and it is very susceptible to blast. Piz confers resistance to two common races of blast, IC17 and IE1, but it does not confer resistance to the common races of IB1 and IB49. Thus, lines containing Piz may show different levels of blast resistance year to year, depending on which races are present.

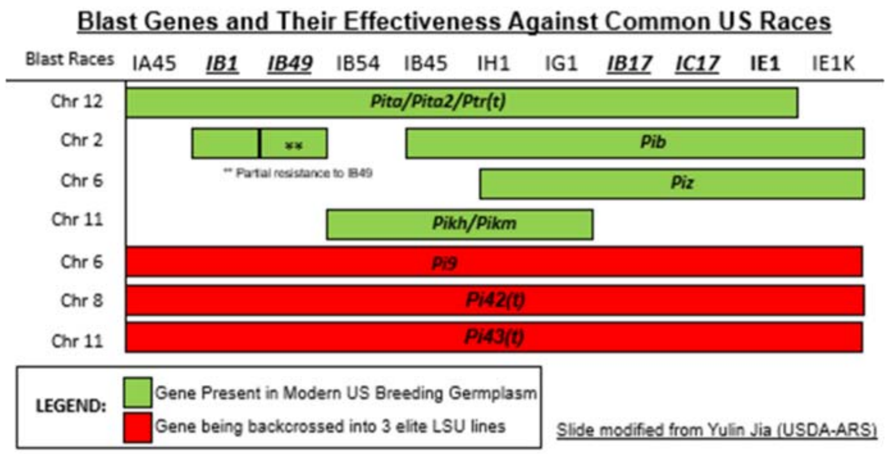

Figure 1

The other gene that is quite common in Louisiana germplasm and varieties is Pikh/Pikm. Figure 1 shows that this gene confers resistance to four races of blast, but none of the most common races. One possibility is that as the Pikh/Pikm gene has become more prevalent in rice varieties over time, the races of blast that it confers resistance to have become less common. For example, this gene confers resistance to the blast race IG1, which was the most common blast race in the 1970s and is now rare. This is an important concept in that as a variety is grown over larger areas of acreage for multiple years, it can shift the predominant races of blast and reduce the observed resistance of the line.

In addition to the characterization of the genes presently in our Louisiana germplasm, Dr. Jia has identified additional genes (Pi9, Pi42, and Pi43) from exotic sources that confer broad resistance across all the common races of blast. Thus, these new resistance genes would offer significant value if they were present in our germplasm and varieties. In 2016, the variety development program at the Rice Research Station began introgressing each of these genes into three different elite varieties: CL153, CL272, and Mermentau. These new genes have been consecutively crossed into our elite lines four times and selection for the target blast gene has been conducted using SNP DNA markers developed at the RRS. The marker selection allows us to ensure we hold onto the desired blast genes without having to measure blast resistance in the field. This has facilitated rapid introduction of these genes into our elite lines in just two years. The first lines from these efforts will be tested in 2018 as BC2F2 rows, and we will test BC3F2 lines in 2019. Having these additional genes in adapted, elite germplasm will facilitate the development of new varieties with alternative sources of blast resistance.

The research activities outlined in this article would not have been possible without the support of the Louisiana rice check-off funds and the support of the Louisiana Rice Research Board. The characterization of the blast genes present in our varieties and germplasm and the breeding activities to incorporate new sources of blast resistance are dependent on the utilization of the SNP DNA marker lab, which was established in 2016 through the support of the Louisiana Rice Research Board.

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Variety	Blast	Blast Resistance Spectrum
Caffey	R	Limited
Catahoula	MR	Broad
Cheniere	MS	Limited
CL111	MS	Intermediate
CL151	VS	Limited
CL153	MS	Broad
CL163	VS	Limited
CL172	MS	Broad
CL272	MS	Intermediate
CLXL729	R	n/a*
CLXL745	R	n/a*
Cocodrie	MS	Limited
Della-2	R	Unknown
Diamond	S	Minimal
Jazzman	R	Unknown
Jazzman 2	MS	Minimal
Jupiter	S	Limited
LaKast	S	Minimal
Mermentau	S	Limited
PVL01	S	Limited
Roy J	S	Minimal
Titan	MS	Intermediate
XL753	R	n/a*
XL760	R	n/a*

Table 8 - Rice Variety and Management Tips

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Focus

Corey Conner

Corey Conner has worked at the H. Rouse Caffey Rice Research Station three times, first as a student worker and twice as a research associate.

After graduating from the University of Louisiana at Lafayette with a bachelor's degree in plant science in 2000, he started working for RiceTec before coming to the Rice Research Station in the summer of 2002 to work with variety development.

He left the station in 2008 to work for BASF to work in a rice yield project across the mid-south. "It was a very tough decision for me but by leaving, it benefitted me because it broadened my horizons."

In November 2016, Conner returned to the station to work in variety development.

Conner grew up in Lake Arthur where his father, Ed Conner, was a rice farmer and an agriculture chemical dealer, so he knew as a boy he would have an ag-based career. "It's something I grew up around. I can't see myself not doing anything associated with agriculture."

He said he enjoys being outdoors and growing a crop. "I like the people here, and it's a great place to work."

Adam Famoso, LSU AgCenter rice breeder, said Corey is an asset to the rice station. "He is a critical component to our breeding efforts, where he oversees all of our field activities on and off station. In addition, he has been an invaluable resource in helping me as I am getting settled with all the various aspects of the program since Dr. Linscombe's retirement."

Corey and his wife, Jan, have two girls and a boy. During his off-time, he works with youth baseball and basketball leagues.

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The LSU Agricultural Center is a statewide campus of the LSU System and provides equal opportunities in programs and employment.