RICE2014

MISSISSIPPI MAFES AGRICULTURAL & FORESTRY EXPERIMENT STATION

Mississippi Rice Promotion Board

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

PROMOTION BOARD

The Mississippi Rice Promotion Board is a group of 12 individuals appointed by the Mississippi Governor's Office to oversee the expenditure of research and promotion funds generated by the state's rice farmers. Each year, research and extension scientists submit proposals to address key issues pertaining to rice production. The board strives to fund proposals that advance rice production in a holistic, programmatic manner, with a major emphasis on applied research.

This report highlights projects funded during the 2014–2015 funding cycle. We hope you find it enlightening and informative. Anytime issues arise on your farm that you believe should be addressed, please speak with one of the board members or contact any of the scientists who contributed to this report.

We appreciate your support of the Mississippi Rice Check-Off Program and wish you much success in 2015.

Mississippi Rice Promotion Board
Ronnie Aguzzi, Chairman
James Allison
Curtis Berry, Secretary-Treasurer
Nolen Canon, Jr.
Gipson Carter
Marvin Cochran, Vice-Chairman
Gary Fioranelli
Donald Gant
Tom Hollingsworth
Randy Howarth
Doug Simmons
Gibb Steele

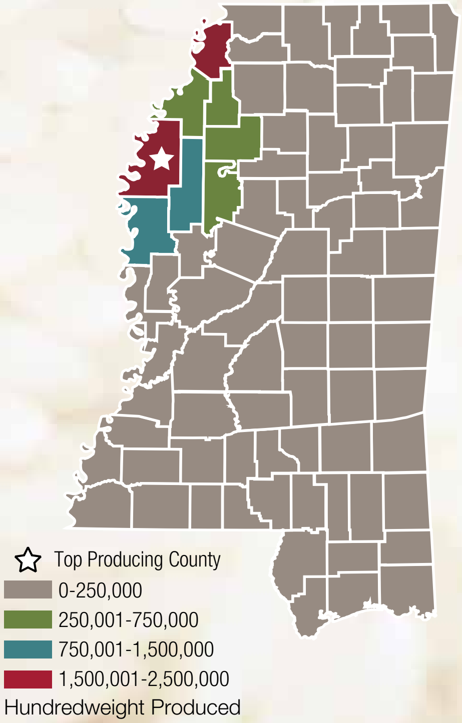
CONTENTS

Rice 2014

13,600,000
hundredweight produced

259 farms

$174 million
value of production



2014 OVERVIEW

Bobby Golden

It was great to get back in a rice field this year. After being out of rice for the last five years, it was a welcome return. It took a little while to get my rice legs back under me, but after the first month of running up and down the road diagnosing issues, I felt comfortable and back at home.

The USDA annual summary for 2014 listed Mississippi's harvested acreage at 190,000 acreage, which was a 53 percent increase from the 2013 harvested acreage, one of the lowest since the late 1970s. Once again Bolivar County led with the most acreage dedicated to rice in the state, with Tunica County coming in second. In 2014, most of the rice acreage was cultivated north of highway 82 with rice seeded in approximately 16 of the 19 Delta counties. Like past years, most of the acreage contained Clearfield technology. The most widely planted conventional variety for 2014 was Rex.

Planting progress in 2014 initiated behind the 5-year average, with less than 20 percent of the state's rice planted by late April. Rainfall recorded at Stoneville for the month of April was almost double that of the 100-year average. However, a great amount of acreage was planted in what could be considered the normal time frame, with the bulk of rice planting occurring between the end of April and the second week of May.

Shortly after rice emergence, herbicide drift was a primary concern in the Delta. In contrast to years past, most of the complaints were not glyphosate, but paraquat and just about anything you can tank-mix with it. It seems that this is a perpetual problem in the Delta and was probably worse this year with a late-emerging rice crop and soybean burndown applications coinciding. Most of the growers reported a turnaround and the affected areas grew out of the drift issues.

It seemed just as soon as the drift issue was resolved, the weather created havoc with preflood nitrogen applications. Most acreage received preflood nitrogen in less than ideal conditions due to the extremely wet early growing season in the Delta. In many instances, producers were fertilizing on wet ground or into the water because of timing issues.

Persistent pest problems also plagued the 2014 growing season, with many fields containing big grasses that were treated post-flood due to the wet conditions, which is not an ideal situation. Armyworms seemed to dominate the landscape throughout the growing season with many border acres treated and some full fields sprayed. Probably the greatest concern in Mississippi in 2014 was rice leaf blast. Historically, Mississippi doesn't have a great deal of blast pressure, but environmental conditions throughout the season coupled with susceptible host cultivars proved troublesome for many. Most of the acres affected with blast were treated before the disease could cause substantial economic loss.

The middle of summer was met with milder than normal temperatures. Average daily high and low temperatures for July averaged approximately four degrees cooler than the 85-year Stoneville average. This helped reduce the negative influence of high temperatures on pollen and more than likely helped offset some of the issues faced throughout the early growing season. All in all with the many setbacks faced throughout 2014, rice producers were very resilient and showed just how great they are by overcoming the early season setbacks and producing an estimated yield of 7420 pounds per acre, an all-time yield record for Mississippi.

Rice Planting Date Effects on Yield and Quality

R. L. Atwill, J. L. Corbin, P. W. Fitts, B. R. Golden

The impacts of planting dates on rice grain yield are well established. However, changes in environment, genetics, and cultural practices often impact the optimum date for planting. Climatic conditions during flowering through grain maturation also impact yield and quality. In 2014, research was continued to evaluate the impacts of planting date on grain and milling yield.

The annual planting date trial was conducted during the 2014 growing season at the Mississippi State University Delta Research and Extension Center on a Sharkey clay soil. Multiple pure line cultivars and F1 hybrids, largely selected on grower popularity, were drill-seeded at 6 total planting dates, with dates initiated on March 27 and concluding on June 16 in approximately 2 week intervals. This range of dates generally captures the range of real world environmental conditions experienced by Mississippi rice producers. The area for each planting date was managed using pest control strategies similar to those recommended by the MSU Extension Service. Plots were fertilized with 150 pounds nitrogen per acre when rice reached the five- to six-leaf stage and within 2 days before permanent flood establishment. Plots were drained 10 to 14 days before harvest. Data was analyzed to determine the optimum period of planting and the rate of change when rice was planted outside of the optimum window.

Results indicated that the optimum planting period was early to mid-May. This optimum date was somewhat later than what long-term data suggests, but can be explained solely by the erratic environment experienced in 2014. The number of days from planting to emergence for rice planted in late-March was 12 to 15 days longer than all other planting dates. The time period between emergence and mid-season (1/2” Internode Elongation) was 10-16

days longer for early planted rice compared to rice planted after May 2. The cool and wet early season led to limited heat accumulation for early seeded rice. Averaged over all planting dates, hybrids reached maturity 3 to 4 days sooner than pure line cultivars. The greatest grain yield was achieved when rice was planted in mid-May for both varieties and hybrids. Pure line cultivars achieved the greatest grain yields until mid-May planting dates, and hybrid cultivars achieved greater yields than varieties when planted later in the growing season. CLXL745, XL753, and Colorado resulted in the lowest whole milled rice at 51, 52, and 53 percent, respectively. The greatest whole milled rice was observed in the latest planting date.

These data demonstrate the impacts of the interaction of cultivar and environment on yield and grain quality. Long term seeding date data over a wide range of cultivars will help aid breeders to select characteristics to develop cultivars that are more stable across a wider range of environments. Annual planting date trials are part of an agronomy maintenance program that greatly helps producers make well informed decisions on when to seed for optimal yield and quality.

The Effect of Various Water Management Strategies on Rice Grain Yield and Nitrogen Use Efficiency

R. L. Atwill, L. J. Krutz, T. W. Walker, J. L. Corbin, P. W. Fitts

The Mississippi Alluvial Aquifer is heavily utilized for irrigation in Arkansas, Louisiana, and Mississippi. Increased use has paralleled rice acreage increases. Field observations have shown that intermittent techniques can achieve water savings of up to 50 percent compared to continuous flooding. These savings are attributed to decreased loss from percolation, field edge seepage, and floodwater runoff. Agricultural use of the aquifer exceeds long-term recharge rates, causing a decline in aquifer levels. The 30-year decline of this resource is cause for concern. This research's objective was to evaluate the impact of alternate rice irrigation strategies on yield and nitrogen use efficiency, and to understand the agronomic and physiological performance of six rice cultivars in the southern U.S.

Experiments, in 2013 and 2014 in Louisiana and Mississippi, evaluated six rice cultivars across four irrigation strategies including:

1. continuous flooding for the drill-seeded, delayed-flood cultural system;
2. straighthead management system, where flood is maintained for 10-14 days, then allowed to drain until soil moisture reaches -33 kPa, followed by continuous flooding until harvest;
3. intermittent irrigation, where flood is maintained for 10-14 days, then allowed to subside until soil moisture reaches -22 to -33 kPa range, then flooding back to 2- to 4-in depth and repeated until harvest; and
4. flush irrigation, where rice is flooded when soil moisture reaches -20 to -33 kPa range, maintained for 12 hours, and then released to imitate a row-irrigation event.

Cultivars included CL151, long-grain semi-dwarf variety with Clearfield® technology; Cheniere and Presidio, both conventional semi-dwarf long-grains; Jupiter, conventional semi-dwarf medium-grain; and RiceTec® hybrids CLXL729 and CLXL745.

In flush irrigated rice, yield reduction ranged from 47 to 55 bushels per acre; plant height reduction was 6 to 7 inches; maturity was delayed as days to 50 percent heading increased by three; and nitrogen use efficiency, yield per unit of nitrogen applied, was decreased compared to other treatments. No differences were observed between continuous, intermittent, or straighthead irrigation for yield, plant height, and nitrogen use efficiency.

The effect of water management on nitrogen dynamics for the cultivars CLXL745 and Presidio were also tested. Intermittent and continuous flooding had higher recovery efficiency values than flush irrigated rice. Nitrogen uptake was lower for flush irrigated rice compared to other treatments. Nitrogen uptake was 6 percent higher in intermittent irrigation compared to continuous irrigation.

Data suggest continuous flood irrigation was not superior to intermittent irrigation in agronomic or physiological performance of six varieties commonly grown in Mississippi and Louisiana.

Intermittent irrigation techniques have shown to decrease water usage by up to 50 percent. Adoption of water-saving techniques can reduce short-term irrigation costs, and may decrease aquifer decline rate in future years. New management practices must be evaluated to determine water saving strategies. Future research will focus on developing intermittent irrigation techniques to accommodate farm-scale production systems.

Row-Crop Irrigation Science and Extension Research (RISER)

R. L. Atwill, L. J. Krutz, D. Roach

The Mississippi State University Row-Crop Irrigation Science and Extension Research (RISER) program, was developed as a science-based approach to evaluating irrigation best management practices for Mississippi producers. The RISER program is designed to assist producers in reducing water use while maintaining yield and profitability. Producers participating in the RISER program agree to allow MSU scientists to manage the irrigation decisions on one field while the producer manages the control.

In 2014, the RISER program began to evaluate water saving techniques for rice production. Multiple-inlet, or side-inlet irrigation is the use of poly tubing to deliver water to each paddy independently that reduces irrigation inputs up to 17 percent as opposed to a single-point (levee-gate) distribution system. Coupling side-inlet with a water management technique such as alternate wetting/drying, also known as intermittent irrigation, is being evaluated in the Mississippi Delta to aid growers in reducing irrigation costs and slow depletion of natural water reservoirs.

The use of intermittent irrigation with side-inlet, called SI-Max, was evaluated on three producer on-farm trials in 2014. Each producer agreed to irrigate one field conventionally through levee gates, one field via side-inlet, and an SI-Max irrigated field. The producer used current management practices on the conventional and side-inlet fields, and the SI-Max was managed by an MSU scientist. Flood in the SI-Max managed fields was allowed to subside to a level determined by the scientist, and irrigation was initiated when soil moisture dropped below field capacity. Water use was monitored using a flow meter on each of the irrigation treatments. Grain yield was calculated using yield monitors in harvest equipment.

Fields managed with a side-inlet irrigation through poly tubing reduced water usage by three acre-inches, and SI-Max reduced irrigation amounts by 11 acre-inches compared to the conventional continuous flood. No yield potential was lost in the side-inlet treatment, and a 3 bushel per acre increase was observed in SI-Max fields. Water use efficiency, used to determine grain yield per acre-inch of water applied, increased in SI-Max by 4 and 5 bushels per acre-inch for side-inlet and continuous flood, respectively. Use of the SI-Max irrigation management system resulted in an average water savings of $33 per acre over the conventional irrigation system.

The RISER program will continue to evaluate best management practices that aid in developing sustainable water management strategies for Mississippi rice producers.

Validation of N-STaR in Mississippi

R. L. Atwill, J. L. Corbin, P. W. Fitts

The development of a soil test that can accurately predict the amount of nitrogen fertilizer needed is still under development. The recent release of the Nitrogen Soil Test for Rice (N-STaR) has made it possible to predict nitrogen requirements on a field-by-field basis. In 2014, a protocol for testing clay-textured soils in Arkansas was released. This research is focused on evaluating the effectiveness of N-STaR on Mississippi rice producing soils by comparing N-STaR recommendation to classical N-response trials conducted each year.

Nitrogen rate response experiments were conducted from 2013-2014 on both clay and silt loam textured soils. Nitrogen rates ranged from 0-210 pounds per acre on silt loam soils and 0-240 pounds per acre on clay soils. In addition, strip trials were conducted on a Sharkey clay soil in 2013 and 2014. Soil samples were collected in the spring of each year and analyzed by the University of Arkansas N-STaR soil test laboratory. The 95 and 100 percent relative grain yield N-STaR recommendations were compared to the nitrogen rate response data from these experiments. Maximum grain yield was compared with yield potentials from the N-STaR relative grain yield recommendations.

On the sites with silt loam textured soils, the 95 percent relative grain yield NSTaR recommendation was greater than the classic model at two of three locations with increases at 36 and 66 pounds of nitrogen per acre that resulted in yield increases of 4 and 5 percent, respectively. The NSTaR recommendation for one silt loam site was lower than the quadratic model suggested, yet resulted in a 10 percent yield reduction. For the clay soil sites, the N-STaR recommendation were consistently lower, averaging 45 pounds nitrogen per acre lower than the classical-based recommendation. Using the 95 and 100 percent grain yield N-STaR recommendation resulted in 7 to 17 percent yield reductions for clay soils depending upon location.

These data suggest the N-STaR recommendations for Mississippi silt loam soils can potentially maintain grain yield while reducing nitrogen application rate. However, for clay soils, the N-STaR system is currently insufficient at optimizing nitrogen recommendations for rice production. In Mississippi, more research is needed to correlate and calibrate the current N-STaR recommendation model.

Palisade® Application to CL151 in a Field Setting

J. L. Corbin, R. L. Atwill, P. W. Fitts

The cultivar CL151 continues to remain a popular variety for Southern rice production because of its high yield potential and herbicide technology package offering greater options for red rice control. One of the main concerns for CL151 is its propensity to lodge, which can decrease harvest efficiency, grain quality, and yield. Over the past three years much effort has been devoted to exploring management practices to reduce lodging for CL151. Previous small plot research investigating Palisade® (trinexapac-ethyl), a plant growth regulator, showed efficacy in reduction of plant height, which in turn may reduce lodging incidence. However, high application rates proved to have a negative impact on grain yield. In 2014, research was established to evaluate the influence of Palisade® application rate in a more commercialized field setting.

Studies were conducted in 2014 at two locations at Mississippi State University's Delta Research and Extension Center. Both locations were seeded at a rate of 75 pounds per acre and nitrogen was applied at 180 pounds per acre pre-flood. Palisade® was applied at 0, 1.37, 2.75, or 5.5 ounces per acre at panicle differentiation at both experimental fields. The trial measured lodging and grain yield.

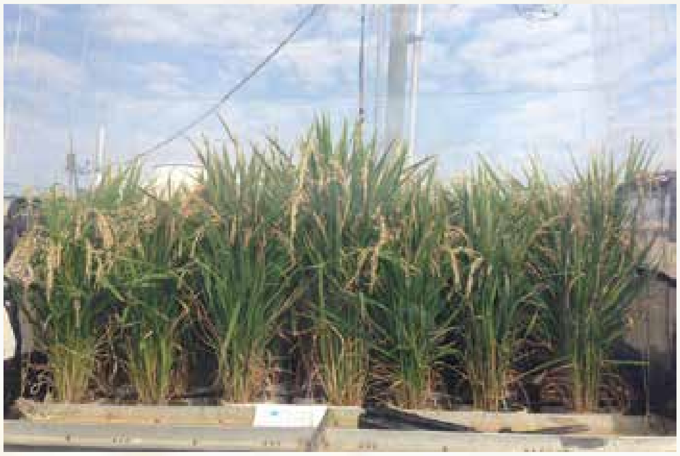
There was no lodging present in either of the fields. At both locations grain yields were greatest when Palisade® was applied at 1.37 ounces per acre, where yields averaged 9,246 pounds per acre. Yields for the 0 and 2.75 ounce per acre treatment were 8,275 and 7,618 pounds per acre, respectively. Palisade® applied at 5.5 ounces per acre recorded the lowest yields averaging 7,618 pounds per acre.

In summary, these data suggest that Palisade® may be an effective tool to increase yield potential when applied at 1.37 ounces per acre. However, it is also evident that Palisade® can be detrimental to the yield when applied at a rate of 2.75 ounces per acre and greater.

Growth and Grain Yield Diversity for High Temperature Tolerance in Rice Cultivars

K. R. Reddy, T. W. Walker

Temperature is a key abiotic stress factor affecting plant growth and development. In the U.S. Midsouth, rice flowering generally coincides with high temperature. However, each season is unique in timing of rain, temperatures, and radiation load, among other factors. When the uniqueness of the weather is combined with individuality of cultural practices such as soils, fertility management, and variety characteristics, it is impossible for rice production managers to adjust accordingly. Producers need simple tools to help make decisions, particularly in selecting a suitable cultivar for a niche environment for planting. High temperatures during panicle initiation and grain-fill can cause substantial reduction in grain yield and quality such as chalkiness of grain due to poor spikelet fertility and lower supply of carbohydrates. Scientists suspect that rice cultivars vary in their response to high temperature. This variability in grain production may be exploited to develop relative scores for the cultivars which can be grown in Mississippi and beyond. To fully understand this variance, a large number of genotypes available on the market were screened for reproductive potential including grain yield. The objectives of this study were to characterize cultivar responses to high temperatures. Twenty one rice cultivars along with a few hybrids and test lines adapted to the U.S. Midsouth region were used. All pots were seeded and grown in the natural environment for 39 days. The pots were then moved into the Mississippi State University Soil-Plant-Atmosphere-Research Facility and were grown at optimum temperatures for another 23 days. Just prior to panicle development, 52 days after sowing, three temperature treatments, optimum, high, and very high temperature treatments were imposed and continued until grain development, 137 days after sowing. The 21 rice cultivars examined in this study exhibited substantial variability in their responses for all the measured traits. The total high temperature response index derived from several parameters that are yield-related was used to classify the cultivars into various groups of temperature tolerance. Significant linear and positive correlations were observed between grain production efficiency and grain yield (slope = 0.168; r^2 = 0.76) and percent grain fill (slope = 2.04; r^2 = 0.84). However, grain production efficiency was poorly correlated with total biomass. The analysis show that grain fill and pollen vitality may be important traits for screening cultivars for high temperature tolerance in rice. Based on the screening methods, Antonio, Nipponbare, RU1004197, CL162, Colorado, and CL152 were recorded as heat sensitive and CL745, CL151, and Cheniere were identified as heat tolerant cultivars. The identified heat tolerant cultivars may be useful for breeders to develop new rice cultivars which could withstand high temperature conditions during the growing season. However, these results should be validated under field conditions to evaluate their performance before recommending them to the producers and breeders in order to accomplish the maximum benefit.



Mississippi Rice Breeding Program

E. Redona, P. W. Fitts, J. L. Corbin, R. L. Atwill, S. Lanford, Z. Dickey

Since its inception in 1986, the Mississippi State University rice breeding program has released six pure line varieties with combinations of key traits such as high yield, pest resistance, and physico-chemical grain characteristics desired by producers, millers, processors, and consumers. The use of these and other new rice varieties suited to intensive management practices has increased rice farming profitability in Mississippi over the years.

To accelerate the gains made thus far in the rice breeding program, 27 new crosses were made in 2014 using new donors for key traits of economic importance along with standard and widely adopted varieties. More than 8,300 plants were selected from 56 F_2 populations involving both the conventional variety and Clearfield® variety development pipelines for winter nursery advancement in Puerto Rico. Over 9,300 breeding lines in various generations from F_3 to F_5 were likewise selected for further advancement and/or initial plot evaluations at the Mississippi State University Delta Research and Extension Center and other selected sites. More than 2,200 promising breeding lines were entered in a series of sequential tests—observational, preliminary, statewide, uniform nursery, and on-farm—the latter involving replicated yield evaluations at seven locations across the Delta.

In the on-farm tests, 14 new MSU-bred lines, including five in the Clearfield® variety development pipeline, had comparable average yield performance across the state as that of Rex (244 bushels per acre), the latest of the conventional varieties released by MSU. Two of these lines, RU1104122 and RU1104077 have been in the final stages of testing during the last few years and are being readied as potential candidates for release. RU1104122, a Clearfield® variety designated as CL163, has 26.4 percent amylose content, has the same milling traits as the Clearfield® standard variety CL151, has some blast disease resistance genes, and has less lodging than CL151. RU1104077, on the other hand, has a yield and disease package comparable to that of Rex and a cooking profile suited for parboiling/industrial uses, and possesses low grain chalkiness that is comparable to that of Cheniere, a good grain quality standard.

Basic seeds of RU1104122 and RU1104077 were produced from panicle selections in Puerto Rico during the 2014 winter season. During the 2014 summer season about 2,000 pounds of breeder seeds for each of these lines were also produced at the Delta Research and Extension Center for potential use in foundation/registered seed production during 2015.

Developing High-throughput Physiological and Root Morphological Screening Tools for Hybrid/Cultivar Vigor in Rice to Optimize Early-season Field Planting

K. R. Reddy, S. H. Jumaa, T. W. Walker

Developing early-season vigorous root growth and photosynthetic machinery (canopy development) under variable field conditions are the key for higher yields in many crops including rice. In one study, 36 rice cultivars, four replications per cultivar, were grown in pots under sunlit conditions until initial flowering. Root and shoot morphological features were assessed for plants grown for 26 days after sowing. Mid-season plant growth and development were measured at mid-flowering, 95 days after sowing. Above and belowground growth and developmental parameters were assessed at 26 and 95 days after sowing. Several root morphological traits were assessed using the winRHIZO root image analysis system at 26 days after sowing. The data collected include 11 root traits including root weight, root/shoot ratio, cumulative root length, surface area, average root diameter, volume, root length per volume, and number of roots, tips, forks, and crossings. Above-ground and plant growth parameters such as plant height, leaf number, leaf area, tillers, time to panicle initiation, and total and plant-component dry weights were measured at 26 and 95 days after sowing. Rice cultivars varied significantly for many traits measured. Individual and cumulative vigor response indices were developed from all the traits and cultivars/hybrids were classified accordingly into different groups. Significant and positive correlations were observed with cumulative vigor response index with leaf area (r^2 = 0.91), tillers (r^2 = 0.78), and total dry weight (r^2 = 0.97) measured at 95 days after sowing. Both root and shoot traits showed significant variability among the hybrids/cultivars for the early-season measurements.

Among the 36 cultivars/hybrids tested, two hybrids (CLXL729 and XL753) showed very high vigor index, nine with moderately high vigor index and 24 with low to moderately low vigor indices. The cultivar, Colorado, showed the lowest vigor index among the 36 cultivars. Based on the relative vigor scores assigned in this study and the yield potential, rice producers could select hybrids/cultivars to maximize rice production in an early planting production system.

A second study was conducted to explore the performance of select cultivars to explore variability among the commercially-available rice cultivar/hybrid seedlings for low and high temperature tolerance using sunlit plant growth chambers. Significant variability among the measured traits was observed among the streptomycin-induced chlorosis cultivars tested.

Herbicide Programs for Barnyardgrass Control in Conventional Rice

J. A. Bond, H. M. Edwards, B. R. Golden, B. H. Lawrence, J. P. Mangialardi

Barnyardgrass is the most common and troublesome weed of rice in Mississippi. Although the Clearfield® system has provided a tool to help manage barnyardgrass, sustainability of this technology is a growing concern. Four Mississippi counties are known to contain populations of barnyardgrass resistant to ALS-inhibiting herbicides, including Newpath, Beyond, Regiment, and Grasp. Barnyardgrass populations resistant to propanil and/or quinclorac are also common in Mississippi. Furthermore, one Mississippi population of barnyardgrass exhibits multiple resistance to quinclorac, ALS-, and ACCase-inhibiting herbicides. Conventional herbicide programs provide an opportunity to rotate herbicide modes-of-action to help alleviate selection pressure on barnyardgrass with ALS-inhibiting herbicides used in Clearfield® rice production. Research is conducted annually in Mississippi to evaluate barnyardgrass control with conventional herbicide programs.

Research was conducted from 2009 to 2014 at the Mississippi State University Delta Research and Extension Center to evaluate barnyardgrass control with conventional herbicide programs. Herbicide treatments were chosen to avoid selection pressure on barnyardgrass with ALS- and ACCase-inhibiting herbicides. Bolero, Command, Facet, Prowl H_2O, RiceBeaux, and SuperWham were utilized in different combinations and at different application timings. Application timings included preemergence, delayed-preemergence, early-postemergence to rice in the two- to three-leaf stage, mid-postemergence to rice in the three- to four-leaf stage, and late-postemergence to rice in the four-leaf to one-tiller stage.

Although rice injury up to 16 percent was observed seven days after some treatments, the injury was transient, and no injury was observed 14 days after

any treatment. Herbicide application timing was critical for barnyardgrass control. For example, control was reduced when Prowl H_2O plus Facet were applied early-postemergence followed by SuperWham late-postemergence compared with the same treatments applied delayed-preemergence followed by mid-postemergence (76 vs. 90 percent at 28 days after late-postemergence application). Total postemergence programs without Command controlled barnyardgrass less than those that included Command early-postemergence. Rough rice yields were lower following Facet early-postemergence followed by RiceBeaux late-postemergence and Prowl H_2O plus Facet early-postemergence followed by SuperWham late-postemergence compared with other sequential herbicide programs.

Data indicated that barnyardgrass can be managed in rice, even if it is resistant to ALS- and ACCase-inhibiting herbicides. However, multiple applications of postemergence and residual herbicides were needed to achieve adequate control of barnyardgrass. When barnyardgrass does emerge, the timing of the postemergence herbicide is critical. A postemergence herbicide application should include premixes or tank-mixtures of herbicides with multiple modes of action. In the event that a propanil-resistant barnyardgrass population evolves multiple resistances to ALS- and ACCase-inhibiting herbicides, control options will be severely limited.

Barnyardgrass Control with Sequential Herbicide Applications

J. A. Bond, H. M. Edwards, B. R. Golden, J. P. Mangialardi, B. H. Lawrence

Wet, cool weather in the spring of 2013 and 2014 delayed herbicide applications in Mississippi Delta rice. Consequently, many applications were made after barnyardgrass exceeded recommended control size. Previous research indicated Regiment as the most effective herbicide for barnyardgrass exceeding one to two tillers in size and Ricestar HT as effective in controlling small barnyardgrass before flooding.

Research at the Mississippi State University Delta Research and Extension Center in 2014 evaluated Ricestar HT and Regiment for barnyardgrass control in rice. Sequential applications of Ricestar HT followed by Regiment and vice versa were applied at five application timing combinations including:

1. early-postemergence followed by mid-postemergence,
2. early-postemergence followed by late-postemergence,
3. mid-postemergence followed by late-postemergence,
4. mid-postemergence followed by seven days after flooding, and
5. late-postemergence followed by seven days after flooding.

The early-, mid-, and late-postemergence applications were made to rice in the two- to three-leaf, three- to four-leaf, and four-leaf to one tiller stage, respectively.

Sequential applications of Ricestar HT followed by Regiment controlled more barnyardgrass 14 and 28 days after treatment than Regiment followed by Ricestar HT regardless of application timing combination. At 28 days after treatment, control differences between the two sequential application treatments ranged from 11 percent for early-postemergence followed by mid-postemergence to 35 percent for the early-postemergence followed by late-postemergence. Control was over 95 percent with Ricestar HT followed by Regiment applied early-postemergence followed by mid- or late-postemergence. The highest control with sequential applications beginning with Regiment was with early-postemergence followed by mid-postemergence. Control with Regiment early-postemergence followed by Ricestar HT mid-postemergence was similar to sequential applications of Ricestar HT followed by Regiment applied at application timing combinations mid-postemergence followed by late-postemergence or followed by seven days after flooding.

For both sequential applications, control decreased as the initial treatment in each application timing combination was delayed from early- to mid- or mid- to late-postemergence. Control was less than 80 percent when either sequential application was initiated mid- or late-postemergence. Similar to control, relative rough rice yields were optimized with sequential applications of Ricestar HT followed by Regiment and when these treatments were made early-postemergence followed by mid- or late-postemergence.

Sequential applications of Ricestar HT followed by Regiment were more effective than Regiment followed by Ricestar HT with all application timing combinations. Furthermore, control and rice yield were reduced following sequential applications initiated mid- or late-postemergence. Barnyardgrass was one- to two-leaf at time of early-postemergence application, but it had reached the tillering stage for application timing combinations initiated at mid-postemergence. Therefore, sequential postemergence herbicide programs should include Ricestar HT applied to one- to two-leaf barnyardgrass and then Regiment applied to control surviving plants.

Research Evaluating Herbicide Drift to Rice

J. A. Bond, H. M. Edwards, B. R. Golden, B. H. Lawrence, J. P. Mangialardi

Mississippi State University Extension Service recommendations are to apply the non-selective herbicide paraquat (Gramoxone SL, Parazone, Firestorm, etc.) mixed with a residual herbicide to control glyphosate-resistant weeds prior to planting corn, cotton, or soybean. Unfortunately, cases of paraquat drift to rice have increased in Mississippi in recent years, but little research has been conducted to evaluate the effect of paraquat on rice growth and yield. A study conducted in 2013 at the Mississippi State University Delta Research and Extension Center showed that rice yield was reduced with Reflex and Metribuzin applied prior to flooding at 25 percent of the use rate. Gramoxone SL reduced rice yield when applied prior to flooding at 12.5 and 25 percent of the use rate.

A follow up study was initiated in 2014 to evaluate the effect on rice of low rates of Gramoxone SL and Reflex applied at different application timings. Simulated drift applications were made at 25 percent of the use rates of Gramoxone SL (three pints per acre) and Reflex (one pint per acre). These treatments were applied very early-postemergence to rice in the one-leaf stage, early-postemergence to rice in the two- to three-leaf stage, mid-postemergence to rice in the three- to four-leaf stage, late-postemergence to rice in the four-leaf to one-tiller stage, or 21 days after flooding.

At 14 days after treatment, rice injury with Gramoxone SL was greatest from early-postemergence applications and least from applications 21 days after flooding. Rice injury following early-postemergence applications of Gramoxone SL was still 74 percent at 28 days after treatment. Gramoxone SL applications very early-postemergence, early-postemergence, mid-postemergence, and late-postemergence delayed rice maturity 2 to 10 days. Rice treated with Gramoxone SL 21 days after flooding never fully matured. All applications of Gramoxone SL reduced rice yield over 13 percent with similar reductions following early-postemergence, mid-postemergence, and late-postemergence applications. Gramoxone SL applications after flooding reduced rice yield 84 percent.

Rice injury 14 days after treatment with Reflex was less than 15 percent regardless of application timing. Reflex applications only influenced rice heading when applied 21 days after flooding, and the delay following this application was only one day. Rice yield was not reduced following applications of Reflex very early-postemergence, early-postemergence, or mid-postemergence; however, Reflex applied late-postemergence and 21 days after flooding reduced rice yield 12 and 36 percent, respectively.

Based on visual estimates of rice injury 14 days after treatment and rice maturity, Gramoxone SL applications were more damaging to rice than Reflex. Effects on rice maturity and yield varied between the herbicides based on application timing. Rice recovered from early-season injury following simulated drift of Reflex with no reductions in rice yield following applications very early-postemergence, early-postemergence, or mid-postemergence. Although the magnitude varied, yield reductions were greatest with either herbicide following applications 21 days after flooding. Yield reductions following 21 days after flooding applications of Gramoxone SL and Reflex were 84 and 36 percent, respectively. Problematically, the greatest visual injury 14 days after treatment from these applications was 28 percent with Gramoxone SL. Therefore, the full extent of the consequences of drift of these herbicides occurring at midseason may not be apparent until harvest. Previous research has shown this to also be the case with drift of glyphosate and Liberty 280.

Fall Armyworms in 2014

J. Gore

Texas A&M University

Fall armyworms are an annual pest of rice in Mississippi. In general, a small percentage of fields need to be sprayed for this insect every year. However, historical levels of fall armyworm were observed in 2014. As a result, numerous fields were sprayed in 2014 and some fields received multiple applications. Fortunately, fall armyworms are easy to control and have a minimal effect on the crop if they are detected early. Fall armyworms tend to have a clumped distribution in rice and are rarely uniform across an entire field. In general, they will not reduce yields in rice unless they significantly reduce stand below acceptable levels. More commonly, fall armyworm feeding will result in stunted plants and delayed maturity of damaged plants. This type of injury is more important than yield losses in many cases because it results in a crop that does not mature uniformly. This makes management decisions difficult for the remainder of the season, especially when a large percentage of a field receives damage.

As mentioned previously, fall armyworms are relatively easy to control in rice. There are two strains of this species, the corn strain and the rice strain. The rice strain typically infests grasses such as pastures and lawns, and is the strain that occurs in rice. Unlike the corn strain, they are highly susceptible to pyrethroids. Mid-rates of any pyrethroid is generally sufficient to provide excellent control of fall armyworm. However, in larger rice that is beyond mid-season, higher rates are often needed to provide acceptable control because the higher rates provide longer residual control. With the outbreak of fall armyworms experienced in 2014, consultants and growers were encouraged by MSU scientists to include Dimilin with weevil spray application. Dimilin is an insect growth regulator that provides long residual control of immature insects and sterilizes adult insects. MSU scientists theorized season long control of fall armyworm could be achieved with this application, which could also provide benefits for rice water weevil control. In all cases, where Dimilin was applied at four fluid ounces per acre at the time of flood, no additional applications were needed for fall armyworm. More research is needed to further access the level of control that can be expected with Dimilin, but it appears that it will be a good tool for management of fall armyworms.

Impact of Foliar Sprays to Supplement Seed Treatments in Hybrid Rice

J. Gore, D. R. Cook, C. Dobbins, W. Wood, B. Olivi

University of Arkansas

An experiment was conducted at the Mississippi State University Delta Research and Extension Center to determine the impact of foliar insecticide sprays on hybrid rice treated with a seed treatment against rice water weevil in 2013 and 2014. Plots were planted on May 15, 2013 and May 8, 2014. The treatments in the 2013 planting included hybrid rice treated with CruiserMaxx Rice and an untreated control. In 2014, the experiment was expanded to include all seed treatments currently labeled. These included CruiserMaxx, Nipsit Inside, and Dermacor X-100. A total of 16 plots were planted for each seed treatment. At the time of the permanent flood, eight plots of each treatment were sprayed with Karate Z. Four weeks after the flood was established, core samples were taken to determine the number of rice water weevil larvae in each plot. Plots were harvested at the end of the season. Overall, rice water weevil densities were low in 2013 and moderate in 2014. Rice water weevil densities were lower in the sprayed plots compared to the unsprayed plots for all treatments except Dermacor. This suggests that rice treated with CruiserMaxx or Nipsit Inside may need to be sprayed with a pyrethroid in some situations. Yields in the trial averaged 264.8 bushels for sprayed CruiserMaxx compared to 255.1 bushels for unsprayed CruiserMaxx rice in 2013. In 2014, the sprayed plots averaged yields 12 to 18 bushels per acre more than the unsprayed plots for CruiserMaxx and Nipsit Inside, respectively. No differences in yield were observed between sprayed and unsprayed plots for Dermacor treated rice. Based on these data, unsprayed CruiserMaxx and Nipsit Inside treated rice yielded higher than sprayed untreated rice in most situations. This suggests that these seed treatments are a valuable component of rice water weevil management in hybrid rice. However, control is not absolute and foliar sprays may provide additional benefits for rice water weevil control and yield in hybrid rice treated with CruiserMaxx or Nipsit Inside. Because of this, rice treated with a seed treatment should be scouted on a regular basis. If evidence of adult feeding on rice leaves is observed, a foliar insecticide application may be needed to minimize injury and maximize yields.

Screen Available Fungicide Chemistries for Sheath Blight Management and Other Diseases to Determine the Best Fungicide Management Alternatives

T. Allen

Three foliar fungicide trials were conducted at the Mississippi State University Delta Research and Extension Center during the 2014 growing season to determine the effects of several different commercially available fungicides as well as experimental products on sheath blight management. All trials were conducted using Cocodrie. Trials considered the response of rice to the new sheath blight material, Sercadis, which is a new mode of action for the rice industry. Sercadis is neither a strobilurin nor a triazole and is considered a carboximide which is an alternative "curative" product similar to a triazole. Trials were conducted with Sercadis alone at several different rates and tank-mixed with Tilt. Sercadis will have a full Section 3 label for use on rice in Mississippi in 2015. Sercadis provided modest yield benefits compared to the nontreated. In addition, trials considered a new experimental fungicide from Cheminova (CHA-073) at several different rates and the new strobilurin product Equation, which is the same active ingredient as Quadris.

Table 1. Rice (cv. Cocodrie) response to fungicide application following inoculation with the sheath blight fungus (*Rhizoctonia solani*). All fungicide products were applied in 0.25% v/v non-ionic surfactant.

Fungicide product	Yield (bu/A)
Untreated	138.0 cd
Quilt Xcel (14 fl oz/A)	149.6 abc
Quilt Xcel (17 fl oz/A)	148.9 abc
Sercadis (4.5 fl oz/A)	127.6 d
Sercadis (6 fl oz/A)	163.9 a
Sercadis (6.8 fl oz/A)	144.1 bcd
Sercadis (6 fl oz/A) + Tilt (6 fl oz/A)	157.4 ab
Sercadis (6.8 fl oz/A) + Tilt (6 fl oz/A)	148.1 abc
Stratego (17.5 fl oz/A)	147.4 abc
Tilt (10 fl oz/A)	142.5 bcd

Table 2. Rice (cv. Cocodrie) response to fungicide application following inoculation with the sheath blight fungus (*Rhizoctonia solani*). All fungicide products were applied in 0.25% v/v non-ionic surfactant.

Fungicide product	Yield (bu/A)
Untreated	144.0 ab
CHA-073 (10.5 fl oz/A)	147.2 a
CHA-073 (21 fl oz/A)	153.0 a
CHA-073 (42 fl oz/A)	154.9 a
Quadris (12 fl oz/A)	145.8 a
Quilt Xcel (21 fl oz/A)	152.5 a
Stratego (17 fl oz/A)	129.7 b
Tilt (10 of/A)	140.6 ab

Table 3. Rice (cv. Cocodrie) response to fungicide application following inoculation with the sheath blight fungus (*Rhizoctonia solani*). All fungicide products were applied in 0.25% v/v non-ionic surfactant.

Fungicide product	Yield (bu/A)
Untreated	129.3
Equation (9 fl oz/A)	145.2
Equation (12.5 fl oz/A)	132.5
Quadris (12.5 fl oz/A)	144.7
Quilt Xcel (14 fl oz/A)	142.8
Stratego (17.5 fl oz/A)	150.5
Tilt (10 of/A)	137.0

Inoculate and Rate the Uniform Regional Rice Nursery (URRN) Trial Entries

T. Allen

Trials were inoculated during the 2014 season and rated for disease incidence and severity prior to harvest. Inoculations were successful and data are currently being entered for analysis as well as bein shared with the Mississippi State University rice breeding team and throughout the rice producing states.

Determine the Sensitivity of *Rhizoctonia Solani* Isolates from Mississippi Rice Fields to the Strobilurin Class of Fungicides

T. Allen

Several isolates were recovered during the 2014 season; however, a more full blown effort will need to be conducted during the 2015 season. Two cultures that were isolated from a heavily infected sheath blight field in Tallahatchie County have been sent to the Louisiana State University AgCenter. A graduate student at LSU is addressing the fungicide resistance issue in Louisiana. Her efforts will help determine whether or not the two isolates are in fact resistant to the strobilurin active ingredients that Mississippi farmers have so heavily relied on to reduce yield loss as a result of sheath blight. The particular field where the two isolates originated had received two foliar fungicide applications (Stratego followed by Quilt Xcel) and had extremely heavy sheath blight pressure. Some preliminary work conducted at Mississippi State University determined that some isolates of *Rhizoctonia* with non-rice origins were in fact resistant to the strobilurin class of fungicides even in situations whereby no fungicides had been applied. Additional work on a much larger scale is necessary in Mississippi to attempt to document whether or not fungicide resistant isolates are present in the state's rice production system. Even though fungicides are available with modes of action that differ from the strobilurin class of fungicides, the members of the strobilurin class of fungicides provide the most beneficial return when sheath blight is present.

University of Arkansas

2014 Variety Trials

B. Golden

Average rough rice yields of varieties, hybrids, and lines evaluated in on-farm trials at seven locations, 2014.

Entry	Choctaw	Clarksdale	Drew	Hollandale	Shaw	Stoneville	Tunica	Average	Stability[1]
	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	
Conventional									
Antonio	203	253	259	262	246	175	249	235	14
Bowman	239	255	257	250	224	209	227	237	8
Cheniere	219	217	265	280	258	211	266	245	12
Cocodrie	200	241	269	271	239	191	256	238	13
Colorado	183	238	242	225	253	153	275	224	19
LaKast	241	247	298	305	270	217	292	267	12
Mermentau	212	211	276	283	250	187	262	240	15
Rex	222	232	285	267	252	202	251	244	11
RoyJ	212	198	256	271	241	219	282	240	13
Sabine	200	217	238	246	224	190	215	218	9
USH13001	199	212	225	171	241	200	241	213	12
XL753	275	280	323	366	305	244	347	306	14
RU1104077	234	238	258	271	223	207	236	238	9
RU1204154	218	215	235	264	240	201	241	231	9
RU1204196	220	229	258	265	252	203	269	242	10
RU1204197	208	239	258	271	249	174	261	237	15
RU1304122	188	227	256	271	253	197	264	236	14
RU1304154	221	248	264	273	252	160	245	238	16
RU1304156	193	225	251	264	243	193	242	230	12
RU1304157	209	237	262	272	251	169	254	236	15
RU1304197	221	243	242	273	227	212	262	240	9
Clearfield									
CL111	199	252	263	293	268	176	269	246	17
CL142-AR	209	213	256	274	218	218	247	234	11
CL151	242	249	287	301	272	234	296	269	10
CL152	204	246	252	269	237	170	232	230	14
CLJZMN	226	241	262	276	260	195	241	243	11
CLXL729	244	280	301	325	292	224	322	284	13
CLXL745	249	285	293	335	312	214	332	289	15
RU1104122	235	239	257	291	237	209	240	244	10
RU1201102	232	229	243	266	249	200	247	238	9
RU1204114	191	236	258	279	247	169	247	232	17
RU1204122	197	246	254	275	243	191	232	234	13
RU1204156	224	237	244	269	235	207	242	237	8
RU1204194	227	257	263	252	252	201	270	246	10
RU1304100	183	226	250	253	230	152	241	219	17
RU1304114	205	215	225	289	227	190	230	226	14
Mean	216	238	261	274	249	196	259	242	
LSD	17	26	16	31	28	31	27	16	
CV	4.8	6.7	3.7	6.8	7.0	9.7	6.5	3.2	
Planting Date	April 24	April 17	March 25	April 24	April 21	May 6	April 21		
Emergence date	May 3-7	April 28 - May 3	April 13-15	May 1-4	May 1-4	May 12-15	May 5-8		

[1]Stability is calculated by dividing the standard deviation by the mean and multiplying by 100. The lower the number, the more stable it is across multiple locations.

VARIETY TRIALS

Average agronomic and milling performance of varieties, hybrids, and lines grown at seven on-farm locations, 2014.

Entry	Origin[1]	Yield[2]	Whole Milled Rice	Total Milled Rice	Chalk	Harvest Moisture	Bushel weight	Plant Height	50% Heading[3]	Lodging[4]	Lodging[5]	1000 Seed weight[6]	Approximate seeds/ pound
		bu/A	%	%	%	%	lb	in	days	%	(1-5)	g	no.
Conventional													
Antonio	TX	235	62.8	70.1	4.3	15.3	44.7	39	88	0	2	23.2	19545
Bowman	MS	237	57.2	67.7	1.9	16.0	45.9	40	90	0	1	25.4	17874
Cheniere	LA	245	60.7	71.1	3.1	15.1	44.4	38	89	0	1	21.6	20991
Cocodrie	LA	238	60.6	69.6	4.5	15.3	45.0	39	90	0	1	23.0	19715
Colorado	TX	224	54.9	68.1	4.5	14.5	42.4	40	84	4	1	25.0	18181
LaKast	AR	267	54.0	68.7	3.2	14.6	44.8	44	89	0	1	25.9	17500
Mermentau	LA	240	61.3	69.3	4.8	15.9	44.4	39	88	0	1	22.3	20398
Rex	MS	244	56.8	66.6	5.3	15.3	44.9	42	90	0	1	26.8	16958
RoyJ	AR	240	57.4	68.8	2.3	18.0	44.4	44	96	0	1	24.1	18827
Sabine	TX	218	61.1	69.0	2.1	15.7	45.9	38	92	0	1	23.7	19191
USH13001	Bayer	213	49.0	66.7	3.4	19.3	35.1	44	89	94	4	26.1	17385
XL753	RT	306	52.5	68.7	6.9	14.7	43.1	43	87	0	1	25.3	17975
RU1104077	MS	238	55.1	66.8	2.8	15.4	46.1	40	90	0	1	24.8	18306
RU1204154	MS	231	58.5	68.8	3.2	14.6	43.8	37	91	0	1	22.2	20477
RU1204196	MS	242	59.2	69.2	3.8	15.1	44.9	42	88	10	1	25.0	18160
RU1204197	MS	237	58.1	67.9	4.0	15.2	44.9	40	89	0	1	24.5	18498
RU1304122	MS	236	62.2	70.8	4.1	14.5	45.2	43	88	0	1	21.3	21300
RU1304154	MS	238	59.4	68.4	4.1	15.0	45.2	40	89	0	1	24.4	18585
RU1304156	MS	230	61.7	70.6	4.4	14.3	45.4	44	88	0	1	21.3	21300
RU1304157	MS	236	59.7	69.0	4.4	15.0	44.7	39	88	0	1	24.3	18716
RU1304197	MS	240	57.9	68.9	4.9	14.9	43.6	39	88	0	1	22.7	20038
Clearfield													
CL111	LA-HA	246	58.9	69.2	6.0	14.3	44.7	41	87	0	1	25.1	18098
CL142-AR	AR-HA	234	50.4	67.4	7.1	18.2	47.2	46	92	0	1	25.9	17500
CL151	LA-HA	269	59.2	68.9	6.7	15.6	45.0	40	89	4	1	23.5	19331
CL152	LA-HA	230	61.0	69.0	3.1	15.5	44.8	40	92	0	1	21.3	21329
CLJZMN	LA-HA	243	59.8	68.7	1.2	14.7	42.9	42	90	0	1	26.0	17481
CLXL729	RT	284	55.6	67.5	5.1	14.7	42.5	44	88	2	1	25.1	18057
CLXL745	RT	289	54.6	68.8	5.2	14.5	42.2	45	85	3	1	26.1	17385
RU1104122	MS	244	57.6	67.7	5.5	15.2	45.0	41	91	1	1	24.7	18391
RU1201102	AR	238	61.4	68.9	2.1	16.3	45.7	37	92	0	1	24.7	18391
RU1204114	MS	232	59.7	69.6	4.4	15.3	44.6	40	88	0	1	23.3	19473
RU1204122	MS	234	60.3	69.5	4.0	15.8	44.2	40	92	0	1	22.4	20268
RU1204156	MS	237	61.2	68.6	3.2	16.5	45.6	38	94	0	1	23.0	19764
RU1204194	MS	246	60.3	68.9	3.5	16.5	44.1	42	89	1	1	24.6	18477
RU1304100	MS	219	58.4	69.0	3.5	14.4	45.2	40	87	0	1	22.3	20372
RU1304114	MS	226	62.1	69.0	2.5	17.3	45.6	39	94	0	1	22.9	19863
Mean		242	58.3	68.8	4.0	16	44	41	89	3	1	24.0	19002.7
LSD		16	1	2	0.5	0.8	1.5	1	2	6	0.4		
CV		7.9	5.6	1.5	35.0	7.4	4.3	5.8	2.7				

[1]Data presented are the averages of 17 total sites that served as the On-Farm Variety Trials for 2012-14. Listed entries were included in all 3 years.
[2]AR = Arkansas; LA = Louisiana; MS = Mississippi; HA = Horizon Ag, in conjunction with the respective state; RT = RiceTec, Inc.
[3]Rough rice at 12% moisture.
[4]Days after emergence.
[5]Percent of plot that was lodged.
[6]Severity of lodging: 1=plants totally erect, 5=plants completely on ground.
[7]Weight of 1,000 kernels.

MISSISSIPPI STATE UNIVERSITY®

EXTENSION SERVICE

MISSISSIPPI AGRICULTURAL & FORESTRY EXPERIMENT STATION