MISSISSIPPI STATE UNIVERSITY

EXTENSION SERVICE

MS AGRICULTURAL AND FORESTRY EXPERIMENT STATION

RICE2015

Mississippi Rice Promotion Board

MISSISSIPPI STATE UNIVERSITY

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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 2016.

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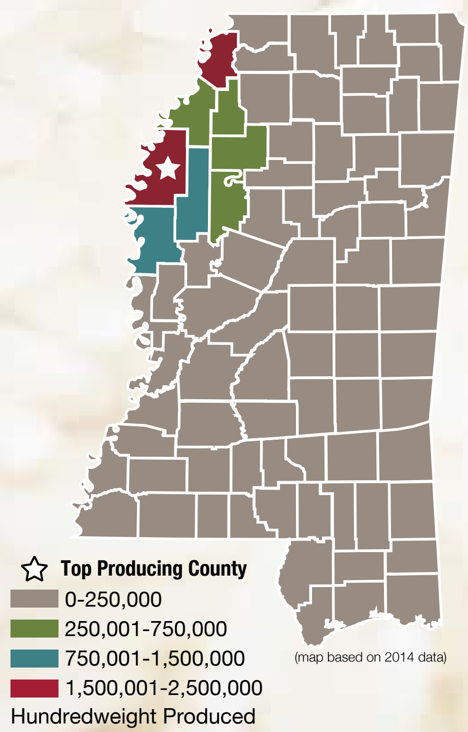
Bobby Golden

Rice 2015

10,800,000 hundredweight produced

259 farms

$132 million value of production



2015 OVERVIEW

Bobby Golden

The USDA-FSA certified approximately 144,000 acres of rice in MS for the 2015 growing season. Certified acres in 2015 were 33% lower than the 187,000 recorded for 2014, but still greater than the 2013 acreage which was the lowest in recent history. Once again Bolivar Co. led with the most acreage dedicated to rice in the state, with Tunica Co. coming in second. Again, in 2015, most of the rice acreage was cultivated north of Highway 82 with rice seeded in approximately 16 of the 19 Delta counties. Yield estimates are lower than the previous two years with USDA suggesting a yield of 7,100 lb/ac. I feel like yields will be off by at least 10% when all the bushels are finally counted.

For most of the state, planting progress occurred at a much more rapid pace than in 2014, where record rainfall in April delayed planting in many areas. This year, as of April 15, only 30% of the total rice crop was planted, however by May 19, 93% was in the ground. This planting pace exceeded the three, five, and ten year historical average, resulting in most areas of the state being planted on time. The exception was in the far Northwest corner of the Delta, were rainfall delayed planting on many farms into early to mid-June.

It seems year after year that herbicide drift calls start picking up shortly after rice emergence with the lion share of calls received centered around paraquat and pre-soybean herbicide tank mix partners. On a positive note we fielded relatively few glyphosate calls in 2015. Most of the fields that experienced some form of drift made a turnaround and were not a complete loss however yield was influenced, especially in the fields that received drift from glyphosate. Off target herbicide drift is a perpetual problem in the Delta. In 2015 the Mississippi Rice Promotion Board sponsored Ben Lawrence, a PhD candidate, to help address the issue with more detailed research on drift and drift management.

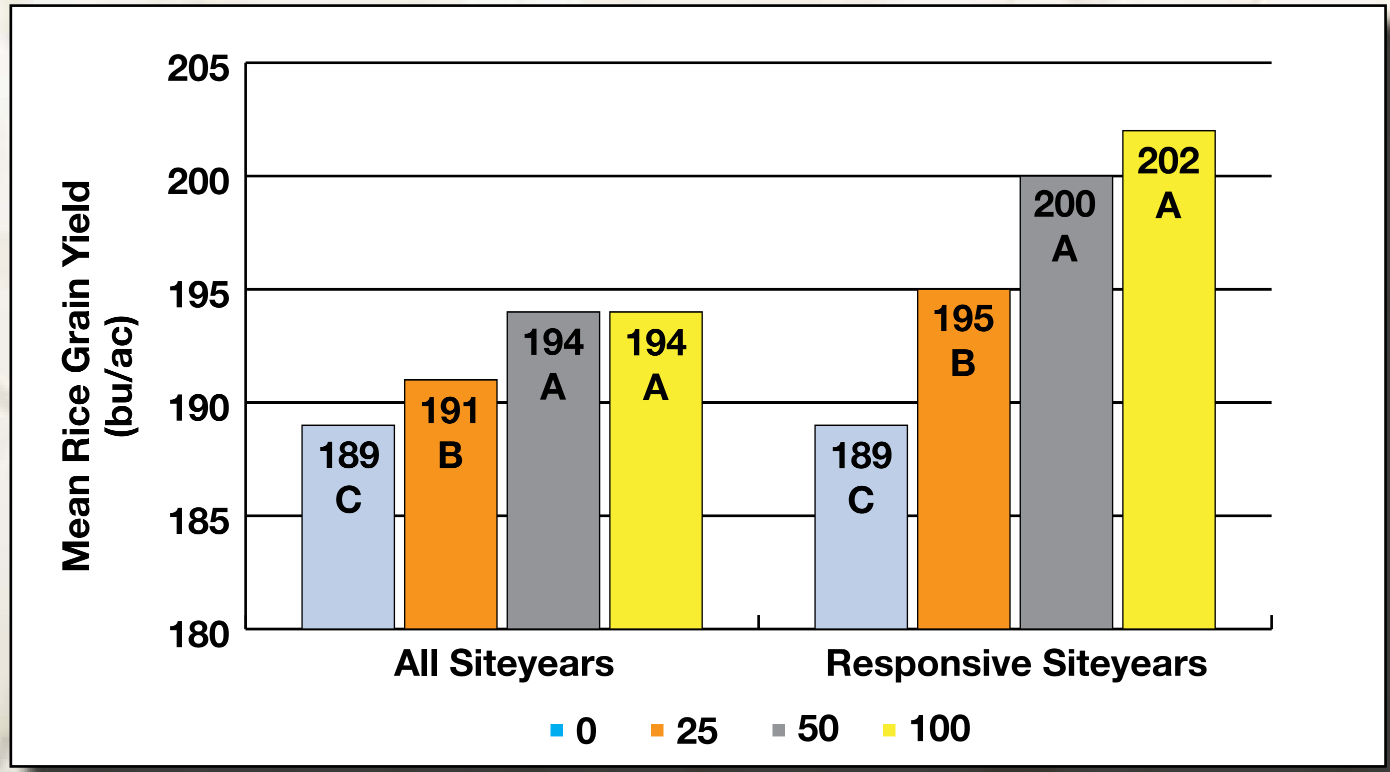
Insect pest issues in 2015 were fairly average with respect to rice water weevil and army worm pressures. Rice stink bug pressure was a different story. Rice stink bug pressure was heavy in the first 10 to 20% of the crop that headed, with many calls from seasoned rice producers and consultants suggesting it was the worst pressure they have experienced. As more rice headed, the pressure dissipated to a more manageable level. Disease pest pressure in 2015 was less than that experienced during 2014 primarily due to the environment. Late season disease complexes took a toll on a limited number of acreage. Particularly, in susceptible varieties with panicle blast causing some significant yield decreases in the central rice growing areas. Most of the influenced acreage may have benefitted from a second fungicide application at or near 75% panicle emergence.

The greatest concern in 2015 and one that definitely contributed to a portion of the reduced yield in the state was excessive heat coinciding with rice flowering and pollination. Stoneville weather data collected throughout the growing season shows that between July 11 and July 30 daily air temperatures never fell below 95ºF, a two day break occurred in the heat then from August 2 through August 12 temperatures were never below 94ºF. Much of the early planted rice headed in this period and experienced some degree of heat induced sterility. Great harvest weather allowed for probably the most timely and uninterrupted harvest I have ever experienced. 2015 shaped up to be what I would consider an average year in comparison to the previous.

Review of Rice Phosphorus Research in Mississippi

Bobby Golden

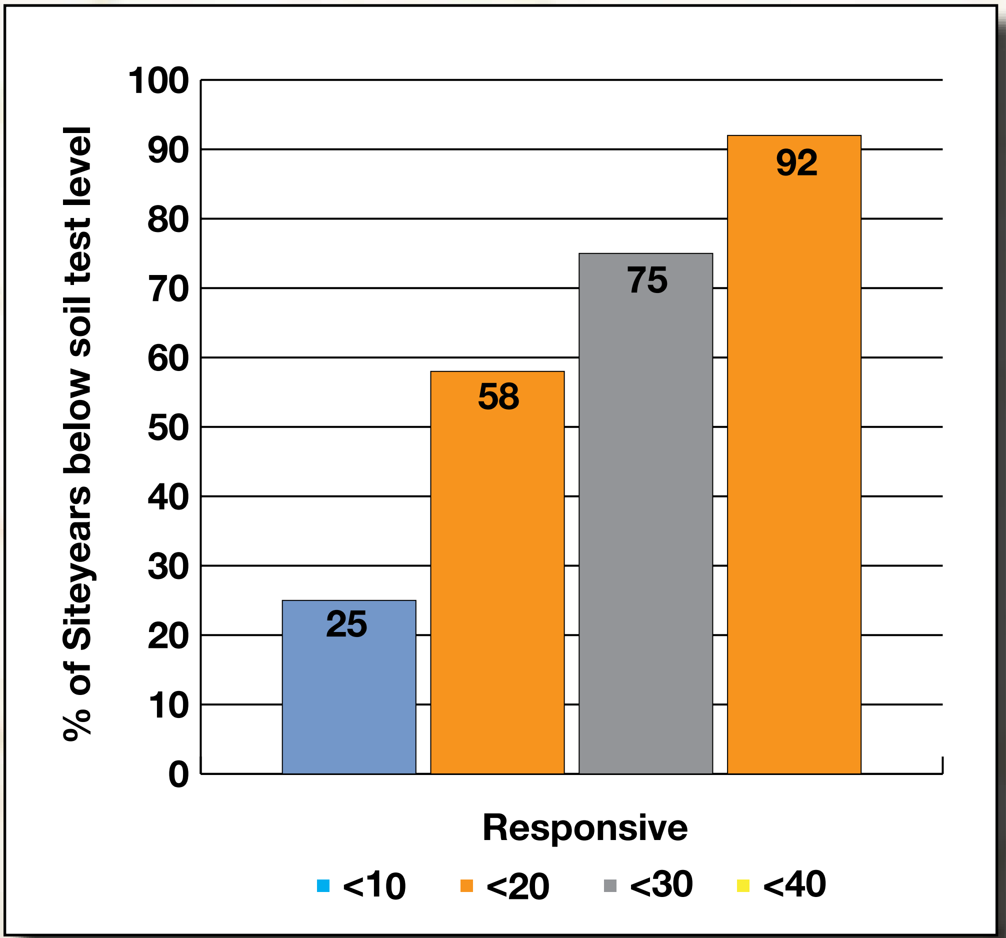
Phosphorus deficiency of rice seems to be a continual issue that sneaks up on us in the Mississippi Delta from year to year. In 2015, we experienced what I would consider an above average amount of P deficiency-related issues. Many of these issues were brought to our attention as potential herbicide issues, however at the end of the day it was phosphorus. Phosphorus deficiency in rice can be char-



acterized by stunting and appear very dark green to almost bluish in color. The most distinctive characteristic of P deficient rice is erect spindly leaves with minimal tillers on the plant. Younger tissue may appear healthy while older tissue can turn brown and become necrotic in severe cases.

Phosphorus research to correlate and calibrate soil tests to describe the relationship between rice grain yield and phosphorus was first initiated in 2002 and the program has been maintained with multiple trials placed across the Delta annually. These trials carry a small footprint but are very powerful in helping establish proper P fertilization practices for rice grown in Mississippi.

Currently with 34 siteyears of data in the model, we still have some difficulties explaining rice grain yield response with soil test P data on low P testing soils. What we have observed over the last ten years is when phosphorus is needed, the timing of the P application is almost as important as the rate applied. In general, optimum P fertilization timing is somewhere between preplant and the 1-2 leaf stage of rice growth and development. Soil test data suggests that when Lancaster P is below 30 lb P/ac we have a greater chance of observing a yield response. When applying P, however, in many instances even when soil test P < 10 lb P/ac, we have not observed responses. Coupling pH with soil test P data has helped, but more research evaluating P fertilization and alternative soil test extractants for rice is needed to produce more precise recommendations.



On-Farm Verification of Intermittent Flood Techniques in the Mississippi Delta

Lee Atwill, Jason Krutz, and Dan Roach

The alluvial aquifer serves as the major source of irrigation water for rice production in Mississippi; however, it is declining at a rate of 300,000 acre feet per year and has done so for approximately 25 years. On average, rice uses approximately 3.0 acre feet per year, which based on average acreage equates to approximately 600,000 acre feet per year. Research in Mississippi has shown that rice can be produced with up to 50% less water than the regional average using multiple-side inlet, alternate wetting and drying (AWD) flooding strategies. The objective of this research is to develop safe and efficient intermittent flood strategies while maintaining yield and improving overall farm profitability and to establish best management practices (BMPs) for Mississippi rice growers, state and federal agencies for an AWD irrigation production system.

An experiment was conducted on eleven grower fields throughout Mississippi in 2014 and 2015 to evaluate yield response of rice grown using multiple side-inlet (MSI) irrigation, and MSI coupled with AWD irrigation as compared to rice grown using conventional continuous water management. Three adjacent fields were chosen on each farm, one for each irrigation treatment. Continuously flooded rice was managed by the grower, while MSI and MSI + AWD managed by MSU. A custom pipe made from 6″ PVC was installed in AWD fields to monitor water level below the soil surface. Irrigation of AWD treatments was initiated when water level reached 4″ below the soil surface. Rice water use was determined using a flow meter in each treatment, and yield was recorded at harvest. Results from grower fields in 2014 and 2015 suggest that rice grown using AWD irrigation reduced water use by 27% compared to conventional irrigation. Rice grain yield was maintained in AWD irrigation compared to MSI and continuous irrigation. Water use efficiency (WUI, bu/ac-in) increased 29% for AWD irrigation compared to continuous flood irrigation. Averaged over 11 sites, 60% of growers exceeded the permitted 36 ac-in for a conventional continuous flood, 36% over using MSI, and 9% exceeded the permit using AWD. Economic analysis results indicate that rice grown using AWD and MSI averaged $30 and $26 per acre greater than continuous flood irrigation, respectively. Rice growers that currently practice intensive water management (n=4) exceeded the permit 25% of time for conventional rice irrigation, however did not exceed the permit using MSI or AWD.

On-farm locations that are not currently practicing intensive water management (n=7) exceeded irrigation pumping permitted values 71%, 43%, and 14% of the time with conventional, MSI, and AWD irrigation, respectively. Compared to continuously flooded rice, MSI alone increased farm profitability $45/ac, and MSI with AWD averaged $52 per acre greater than continuous flooded irrigation practice. Irrigation water applied was reduced by 10 ac-in, on average using AWD irrigation compared to conventional irrigation, and maintained equivalent grain yield. These data suggest that rice grown using AWD irrigation can improve WUI compared to using continuous flooded rice, reduce irrigation pumping amounts, and improve overall farm profitability for Mississippi rice producers.

	Yield	Water Use	WUI	Profitability
	-- bu/ac--	-- ac-in --	-- bu/ac-in --	-- $/ac --
Conventional	163/ac*	32.7/ac	5.0/ac	500/ac
MSI**	169/ac	30.5/ac	5.5/ac	526/ac
MSI + AWD	167/ac	23.7 ac	7.0/ac	530/ac

* Means followed by the same letter are not signfinicantly different at P ≤ 0.05.
** MSI- Multiple side inlet

Development of Intermittent Flood Management System In the Mississippi Delta

Lee Atwill and Jason Krutz

Rice irrigation currently accounts for the greatest amount of irrigation water applied per acre over corn, soybeans, and cotton in the mid-south. Permitted irrigation withdrawals for fields in rice production in Mississippi are limited to 36 ac-in per year. Recent data suggests that rice producers often exceed this permitted value, and water saving irrigation practices must be validated prior to wide adoption. This study was conducted to determine whether safe and efficient alternate wetting and drying (AWD) water management can be achieved while maintaining yield and improving overall farm profitability.

An experiment was conducted at the Delta Research and Extension Center in Stoneville, MS to evaluate the yield and physiological response of rice to several alternate wetting and drying (AWD) irrigation regimes. Three rice cultivars, CL151, Rex, and XL745 (RiceTec®) were evaluated in six different rice irrigation treatments. Irrigation treatments included: a continuous flood, allowing the flood to recede to the soil surface, 4″ below the soil surface, 8″ below the soil surface, 12″ below the soil surface, and 16″ below the soil surface. Water level in each paddy was monitored and irrigation events were triggered at each respective threshold back to a 4″ flood, then allowed to subside until threshold was reached. Urea (150 lbs N/ac) was applied at first tiller, and a 4″ flood was established and maintained for 14 days on all treatments. Irrigation treatments were then initiated until flowering, at which time a 4″ depth flood was maintained in all treatments. Water treatments resumed after rice plots reached 100% heading until two weeks prior to harvest. Rice plots were harvested at 18-20% moisture and yields were calculated for rice at 12% moisture content. A conventional herbicide program and Clearfield® herbicide program were also evaluated in AWD irrigation and compared to a continuous flood. Experimental plots were over-seeded with barnyardgrass and were evaluated for barnyardgrass control.

Rice grain yield response of two AWD treatments were equal to rice grown with a continuous flood. A ten bushel grain yield increase was observed when the flood within a paddy was allowed to recede to the soil surface compared to a continuous flood. Grain yield for continuous flood was equal to rice grown with flood receding to 4″ below soil surface. Reduction of grain yield was observed when the flood receded past 8” below the soil surface as compared to continuous flood. Control of barnyardgrass in experimental plots was not different for rice grown under continuous flood compared to AWD (8″ below soil surface). Barnyardgrass control for Clearfield® rice herbicide program in AWD and continuously flooded rice was 93% pooled over all herbicide treatments. For conventional rice, barnyardgrass control (pooled over all herbicide treatments) for continuous irrigation averaged 74% control, while AWD irrigation averaged 82% control.

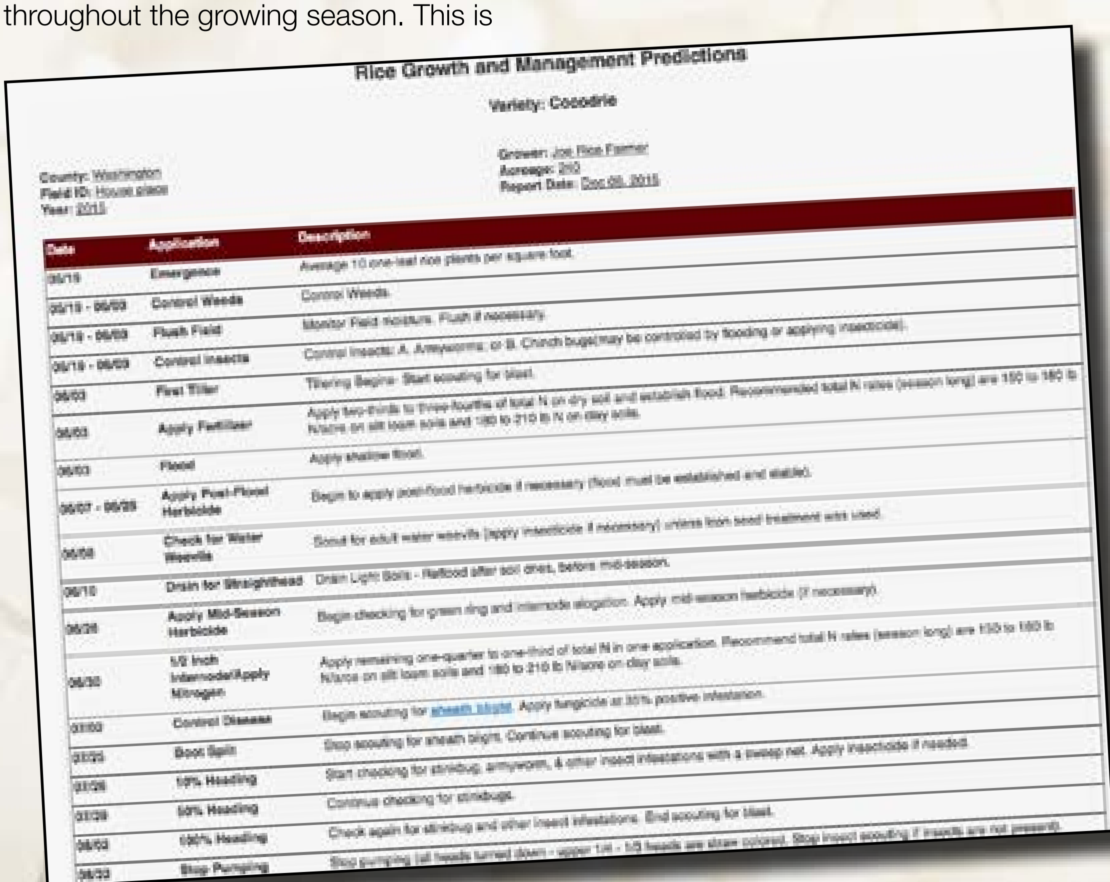
Data from this experiment in 2015 suggest that allowing flood to subside to 4 inches below the soil surface does not result in yield loss compared to a continuous flooded system. Water management practices that reduce groundwater withdrawals are a viable option for rice producers in the mid-south. Weed control for AWD irrigation is maintained using current herbicide programs for conventional and Clearfield® rice production systems. Rice water management using AWD irrigation reduces cost of fuel for pumping while maintaining yield potential thus improving overall profitability.

AGRONOMY

Rice DD 50 App Makes the Program Easy For Smart Phone Use

Mark Silva

Producers and researchers in the intensive agricultural region of the Mississippi Delta have a tremendous need for weather information to develop critical research and management strategies for planting, fertilizing, and harvesting as well as the timing of other critical production practices on Rice planted in the Delta. This project's goals are to continue data collection and dissemination of pertinent weather data and products that are used by researchers and farmers to increase the availability and quality of the data and products available. This data is used for our research to indicate various weather patterns that a rice crop receives throughout the growing season. This is beneficial in making management decisions. The Rice DD 50 management program monitors plant growth and quality of rice entries in various variety demonstrations across the state as well as for rice growers. Also it can be helpful in justifying insect and disease timing applications as well as harvest dates that might be later than the norm. This information should be especially valuable for the years of extreme drought and high temperatures. The information available, primarily on the interactive website www.deltaweather.msstate.edu, has contributed greatly to the actual and potential annual savings for rice producers. The Rice DD 50 program allows farmers to reduce their risks and thus avoid possible losses due to untimely applications and management decisions. The program recently provided an app for the DD 50 Program for smart phone use. The app can be downloaded at http://webapps.msucares.com/



Rice Growth and Management Predictions

Variety: Cocodrie

County: Washington
Field ID: House place
Year: 2015

Grower: Joe Rice Farmer
Acreage: 240
Report Date: Dec 08, 2015

Date	Application	Description
05/19	Emergence	Average 10 one-leaf rice plants per square foot.
05/19 - 06/03	Control Weeds	Control Weeds.
05/19 - 06/03	Flush Field	Monitor Field moisture. Flush if necessary.
05/19 - 06/03	Control Insects	Control Insects: A. Armyworms; or B. Chinch bugs(may be controlled by flooding or applying insecticide).
06/03	First Tiller	Tillering Begins- Start scouting for blast.
06/03	Apply Fertilizer	Apply two-thirds to three-fourths of total N on dry soil and establish flood. Recommended total N rates (season long) are 150 to 180 lb N/acre on silt loam soils and 180 to 210 lb N on clay soils.
06/03	Flood	Apply shallow flood.
06/07 - 06/29	Apply Post-Flood Herbicide	Begin to apply post-flood herbicide if necessary (flood must be established and stable).
06/08	Check for Water Weevils	Scout for adult water weevils (apply insecticide if necessary) unless from seed treatment was used.
06/10	Drain for Straighthead	Drain Light Soils - Reflood after soil dries, before mid-season.
06/28	Apply Mid-Season Herbicide	Begin checking for green ring and internode elogation. Apply mid-season herbicide (if necessary).
06/30	1/2 Inch Internode/Apply Nitrogen	Apply remaining one-quarter to one-third of total N in one application. Recommend total N rates (season long) are 150 to 180 lb N/acre on silt loam soils and 180 to 210 lb N/acre on clay soils.
07/03	Control Disease	Begin scouting for sheath blight. Apply fungicide at 30% positive infestation.
07/25	Boot Split	Stop scouting for sheath blight. Continue scouting for blast.
07/26	10% Heading	Start checking for stinkbug, armyworm, & other insect infestations with a sweep net. Apply insecticide if needed.
07/29	50% Heading	Continue checking for stinkbugs.
08/02	100% Heading	Check again for stinkbug and other insect infestations. End scouting for blast.
08/22	Stop Pumping	Stop pumping (all heads turned down - upper 1/4 - 1/3 heads are straw colored). Stop insect scouting if insects are not present).

Effect of Early-Season Soil Moisture Stress on Growth and Development of Different Rice Cultivars

Bhupinder Singh, Timothy Walker, Ed Redoña, and Raja Reddy

Drought stress in rice affects several crop growth and physiological processes. However, in order to increase the sustainability of rice production in the US Mid-South, producers are now considering intermittent irrigation, instead of continuous flooding, as a management strategy to increase rainfall capture and reduce water pumping. Moreover, in the Mississippi Delta where permanent flooding is established after V4 growth stage, rice seedlings may be subjected to early-season moisture deficits. A greenhouse experiment was conducted to evaluate the performance of 15 commonly grown rice cultivars to early-season soil moisture stress. The rice seedlings were subjected to three different soil moisture regimes – i.e. 100, 66, and 33% field capacity, from 10 to 30 days after sowing (DAS). Morpho-physiological parameters including root traits were measured during the stress period (25 to 30 DAS). Significant moisture stress x cultivar interactions were found for most measured parameters. A cumulative drought response index (CDRI) was developed by summing the individual response index values of all parameters of a given cultivar. The CDRI values varied from 22.87 to 30.72 for the cultivars tested. Rice cultivars, Cocodrie, Lakast, CL152, XL753, CL XL729, CL XL745, and RU1204122 showed low CDRIs, Cheniere, Mermentau, Rex, CL 111, and RU1304154 showed moderately low CDRIs and CL142AR, CL151, RU1104122, recently released CL163 showed high drought tolerance. Significant linear correlation (R2 = 0.65) was obtained for root to shoot parameters using regression analysis. The drought tolerance ratings among the rice cultivars will help rice producers select a variety best suited to their rice-growing environment. Additionally, rice breeders may select the drought tolerant varieties identified as parents to develop cultivars adapted to current and future rice growing conditions.

Rice cultivar classification for early-season drought tolerance based on root and shoot morphological traits.

Low Tolerant CDRI = 22.87-26.11	Moderately Tolerant CDRI = 26.12-29.35	Highly Tolerant CDRI = 29.36-32.59
COCODRIE LAKAST CL152 XL753 CLXL729 CLXL745 RU1204122	CHINERE MERMENTAU REX CL111 RU1304154	CL142-AR CL151 RU1104122

Low drought-tolerant (CDRI ≤ minimum CDRI + 1.0 SD)
Moderately drought-tolerant (minimum CDRI + 1.0 SD < CDRI ≤ minimum CDRI + 2.0 SD)
High drought-tolerant (minimum CDRI + 2.0 SD < CDRI ≤minimum CDRI + 3.0 SD)

Developing a Screening Tool for Osmotic Stress Tolerance Classification Based on In-Vitro Seed Germination of Rice Cultivars

Bhupinder Singh, Timothy Walker, and Raja Reddy

The dry-seeded, delayed-flood culture with alternate wetting and drying weather irrigation management options to grow and sustain rice is favored in the mid-south. Understanding the variation in response to soil moisture deficit among rice cultivars during seed germination would benefit in management and in breeding programs. An in-vitro experiment was conducted to study the impact of osmotic stress using polyethylene glycol (PEG) on germination properties of 15 rice cultivars commonly grown in the US mid-south production system. Time-series for seed germination was developed at wide range of osmotic potentials, 0 to -1.0 MPa, with -0.2 MPa increments. Cumulative seed germination over time was fit to a 3-parameter sigmoid function to derive seed germination rate (SGR), maximum seed germination (MSG), and maximum osmotic potential when seed germination is zero (MSGOPmax), and maximum osmotic potential when seed germination rate was zero (GROPmax). Cultivars differed significantly for MSG, SGR, MSGOPmax, and GROPmax. Maximum seed germination percentage and SGR significantly decreased with increasing osmotic stress. Cumulative drought response indices (CDRI) were derived by summing individual response index values for the derived parameters for each cultivar. Rice cultivars were classified based on means and standard deviations of CDRI into low, moderately, and high drought-tolerant groups. Cheniere was identified as the least tolerant and RU1204122 as the most tolerant to drought based on the seed germination traits. The identified tolerance and the numerical scores among the rice cultivars will be helpful for rice producers to select a variety best suited for a niche environment and rice breeders to develop drought tolerance among the cultivars for current and more variable future climatic condition.

Rice cultivar classification for early-season drought tolerance based on root and shoot morphological traits.

Low drought-tolerant (CDRI < 3.14)	Moderately drought-tolerant (CDRI = 3.15 - 3.34)	Highly drought-tolerant (CDRI = 3.35 - 3.54)
Cheniere (2.94)	CL111 (3.23)	Cocodrie (3.35)
CL151 (2.96)	Lakast (3.27)	Rex (3.37)
CLXL729 (2.97)	XL753 (3.27)	RU1104122 (3.37)
Mermentau (3.02)	CL152 (3.30)	CLXL745 (3.37)
CL142-AR (3.03)		RU1304154 (3.45)
		RU1204122 (3.52)

Low drought-tolerant(CDRI ≤ minimum CDRI + 1.0 SD)
Moderately drought-tolerant (minimum CDRI + 1.0 SD < CDRI ≤ minimum CDRI + 2.0 SD)
High drought-tolerant (minimum CDRI + 2.0 SD < CDRI ≤minimum CDRI + 3.0 SD)

Nitrogen Fertilizer Response Profiles for New and Emerging Rice Varieties

Bobby Golden, Justin McCoy, Richard Turner, Lindsey Bell, Robert Sullivan, and Willie Earl Clark

As new rice varieties are brought to market it is a necessity to have an agronomic package in hand to know how the variety will perform in response to differing management strategies. Nitrogen is by far the nutrient that producers spend the most money on and can influence rice grain yield more so than any other under normal production practices. Trials are conducted annually across the Delta to determine the appropriate nitrogen rate for new varieties across a range of soil textures.

Varieties for 2015 testing were CL163, CL172, LaKast, XP760, and RU1104077 (potential new release from MSU). At each testing location 5 total nitrogen rates were evaluated and compared to an untreated control that received no nitrogen. Nitrogen rates ranged from 0-220 lb N/ac for clay soils and 0-180 lb N/ac for silt loam soils. Each trial was arranged as a factorial and replicated four times. All Nitrogen was applied in a two-way split method with 75% of total N applied preflood and the remainder applied at mid-season.

In general for each variety as nitrogen rate increased yield potential increased before reaching a plateau around 200 lb N/ac on clay soils and 150 lbs N/ac on the silt loam soils. On both clay and silt loam soils the greatest numerical yield was achieved with XP760 the only hybrid rice variety entered into the 2015 trials. The newly released MSU bred CL163 required 200 lb N/ac to maximize yield on the clay soil and 150 lb N/ac on the silt loam. Lakast yields on the clay soil continued to increase throughout the N application range, but for the silt loam were maximized at 180 lb N/ac. Dissimilar to Lakast and CL163, CL172 maximized yield on clay soils with 160 lb N/ac, while on the silt loams 150 lb N/ac was needed to produce top yields. RU1104077 an experimental line from MSU produced the numerical least grain yield at each nitrogen rate when compared to other varieties in 2015. The nitrogen response profile for RU1104077 was similar to that of CL172 on both the clay and silt loam soils. These data are preliminary in the sense that we would like to have three to four years of N management data for a variety before a full N recommendation can be made.

Mean grain yield response of new rice cultivars to nitrogen rate on clay soils in Mississippi during 2015.

N Rate	Mean Rice Gain Yield by Variety (bu/ac)				
(lb N/ac)	LaKast	CL163	CL172	XP760	RU1104077
0	85	111	74	104	85
80	117	143	122	170	112
120	141	170	134	186	130
160	171	172	164	218	150
200	185	183	165	219	157
220	195	189	167	230	165

Mean grain yield response of new rice cultivars to nitrogen rate on silt loam soils in Mississippi during 2015.

N Rate	Mean Rice Gain Yield by Variety (bu/ac)				
(lb N/ac)	LaKast	CL163	CL172	XP760	RU1104077
0	80	117	101	121	95
60	146	155	145	177	123
90	154	185	154	191	136
120	166	177	160	209	149
150	187	196	181	208	159
180	193	197	177	197	173

BREEDING

Mississippi Rice Breeding Program

Ed Redoña, Paxton Fitts, Whitney Smith, Zach Dickey, Jennifer Corbin, Scott Lanford, and Graham Hollister

To provide Mississippi rice producers with high-yielding varieties adapted to the local growing conditions, Mississippi State University established a rice breeding program in 1986. To date, the breeding program has developed five conventional and two Clearfield® pureline varieties with combined characteristics such as high yield, disease resistance, and good grain quality as desired by producers, millers/processors, and consumers. On average, the program has released one new variety every four years. The adoption of these new varieties by producers in the Mississippi Delta has increased the profitability of rice production over the years.

During 2015, several new strategies aiming to further increase the efficiency of rice varietal development in Mississippi were initiated: (1) A new set of donor germplasm for key traits such as yield, resistance to diseases such as blast, tolerance to environmental stresses such as heat and salinity, and grain quality traits preferred in target export markets were obtained from the germplasm collections of the International Rice Research Institute and the USDA. These new genetic donors will be used in crosses to enrich and broaden the genetic base of future Mississippi rice varieties; (b) Using an outsourcing strategy, an active set of over 100 core breeding materials are being analyzed with over 1,000 single nucleotide polymorphisms (SNPs) DNA markers to determine their genetic makeup for future genetic and breeding applications; and (c) more than 100 new cross combinations were generated to develop key genetic mapping and breeding populations for important traits such as disease resistance and grain quality that can be used for both conventional and molecular breeding.

In the Puerto Rico winter nursery, more than 6,000 panicles were selected from 8,500 rows derived from over 50 crosses involving both conventional and Clearfield® materials for further evaluation. In all, over 14,000 early-generation breeding lines in the F3 to F5 generations were evaluated in Stoneville during the summer and over 1,000 were selected for initial small plot evaluations. For multistage, sequential yield testing, over 2,000 promising breeding lines were entered in the observational, preliminary, statewide, multi-state/uniform, and on-farm trials conducted at two to up to seven sites each. Many new promising entries were identified in each of these tests for further sequential yield evaluation and variety pipeline advancement. The on-farm variety trials were conducted at seven locations; Tunica, Clarksdale, Ruleville, Shaw, Choctaw, Stoneville, and Hollandale.

The Clearfield® breeding line RU1104122 was released and initially commercialized by HorizonAg during the year. Designated as CL163, this long grain variety offers a 'Newrex' cook type, with an amylose content of 26% compared to 20% of current long grain varieties, making it ideal for parboiling, canning, food service and package rice. CL163 has a much improved yield over other high amylose varieties, with field yields competitive to CL111 and CL151. It is semi-dwarf, early-maturing, and has good straw strength. The release of another conventional breeding line RU1104077 is under process. This line has a yield and disease package comparable to that of Rex, the most popular conventional variety in Mississippi, with a 'Newrex' cook type and low grain chalkiness. Breeder seeds of RU1104077 were provided to the MAFES Foundation Seed unit for initial foundation seed production in anticipation of future varietal release.

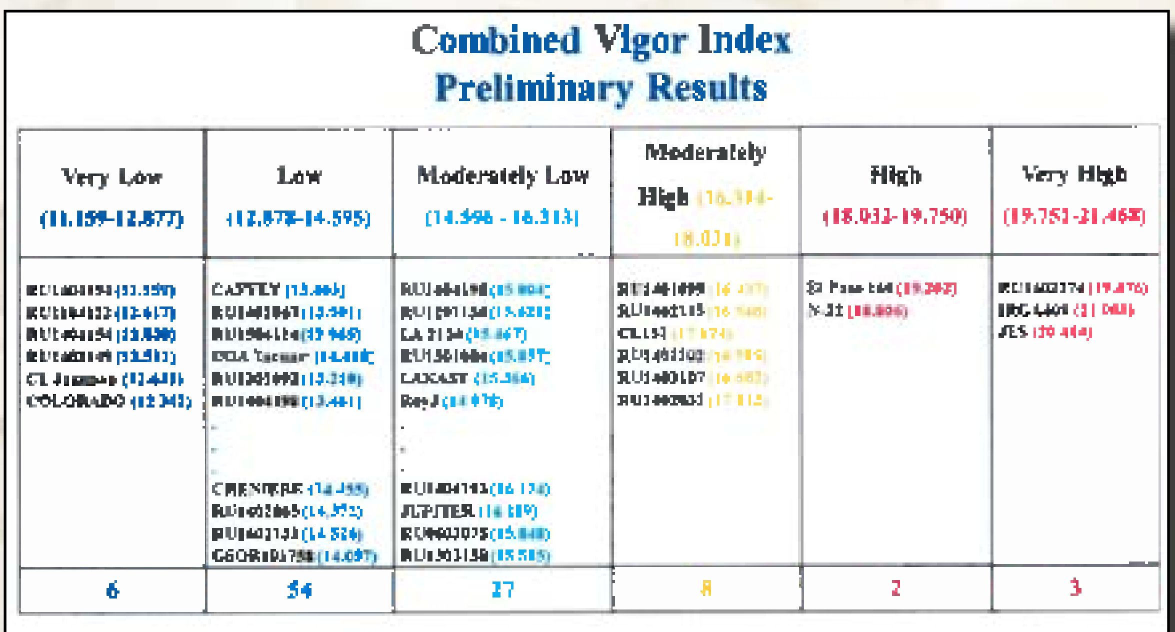
MSU breeder Ed Redoña discusses the new varieties developed by the rice breeding program at the Delta Research and Extension Center's 60-acre rice breeding field plots in Stoneville, MS during the Mississippi Rice Producers' Field Day, July 30, 2015.

BREEDING

High Throughput Phenotypic Characterization and Classification of Rice Breeding Lines for Early- and Reproductive Stage Vigor

Salah Jumaa, Ed Redoña, and Raja Reddy

Holistic and stage-specific cultivar screening are needed to improve rice genotypes for tolerance to abiotic stresses. Early-season vigor that includes the whole-plant system is critical to canopy development for maximizing efficiency of the photosynthetic machinery. The objectives of this study were to evaluate root and shoot morphology and growth of over 100 key rice-breeding lines used in the Mississippi rice breeding program during early season and to develop a screening tool to classify them into different vigor groups. An outdoor experiment was conducted in pots, with five replications per line, under optimum water and nutrient conditions. Above- and below-ground growth and developmental parameters were assessed at 30 days after transplanting. Root morphological traits namely, root weight, root/shoot ratio, cumulative root length, surface area, average root diameter, root volume, root length per volume, and number of roots, tips, crossings, and forks, and longest root length were assessed using the winRHIZO root image analysis system and growth measurements. Above-ground plant growth parameters such as plant height, leaf area, and leaf and tiller numbers were also measured. Rice breeding lines varied significantly for many of the traits measured. Individual and cumulative vigor response indices were developed using all the traits and means and standard deviations were used to classify the breeding lines into different vigor groups. The combined vigor indices for the lines tested ranged from 11.2 (RU14041194) to 20.4 (JES). Only 5% and 6% of the rice lines showed high to very high and very low vigor indices, respectively. The majority (81%) exhibited low and moderately low vigor indices. In addition to early-season vigor, experiments were conducted to characterize morpho-physiological and reproductive vigor traits such as photosynthesis, stomatal conductance, transpiration, canopy temperatures, pigments, cell membrane thermostability, plant height, leaf and tiller numbers, yield-bearing tillers and grain yield, on the same 100 rice lines. The early- and reproductive-stage vigor index database will be useful in developing new varieties most suitable to the mid-south rice-growing environment.


Combined Vigor Index
Preliminary Results

Very Low (11.159-12.877)	Low (12.878-14.595)	Moderately Low (14.596 - 16.313)	Moderately High (16.314-18.031)	High (18.032-19.750)	Very High (19.751-21.468)
[illegible]	CAFFEY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	N-22 [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		JES [illegible]
[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]		
COLORADO [illegible]	[illegible]	[illegible]	[illegible]		
	.	.			
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	[illegible]	[illegible]			
	[illegible]	JUPITER [illegible]			
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6	54	27	8	2	3

2015 Foundation Seed Stocks Project Report Summary

Brad Burgess

In 2015 Foundation Seed Stocks increased seed of "Mermentau" and MSU advanced the breeding line "RU1104077."

Mermentau was produced on Mississippi State University's main campus and foundation seed of the RU1104077 was increased at the North Mississippi Research and Extension Center in Verona.

Field productions of both varieties proceeded normally and numerous roguings to remove any non-typical plants were conducted throughout the growing season. Plant uniformity at harvest appeared excellent.

Following harvest, preliminary seed testing has yielded results consistent with an expectation of quality end products. Seed conditioning, treating, and packaging are scheduled to take place in January, 2016.

Sufficient surplus seed supply of "Rex" remaining from the 2014 production is currently being held in cold storage to fill 2016 seed orders.

ENTOMOLOGY

Managing Rice Water Weevil in Mississippi Rice

Jeff Gore, Chris Dobbins, Bobby Golden, and Don Cook

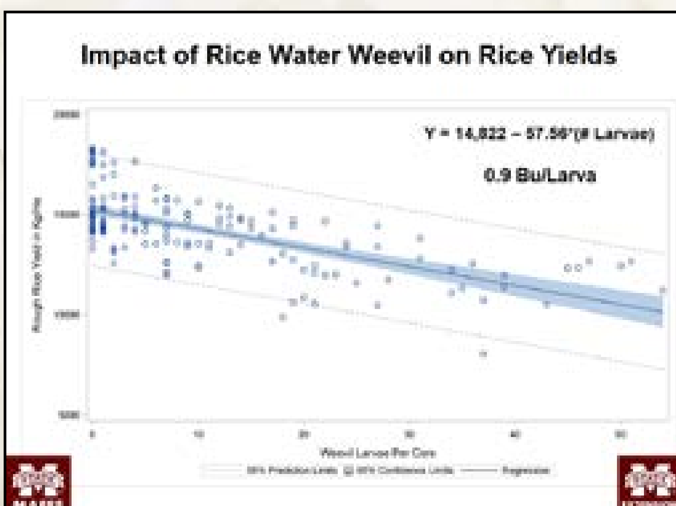
The rice water weevil is the most important insect pest of rice in Mississippi. Approximately 80% of rice in Mississippi experiences significant infestations annually.

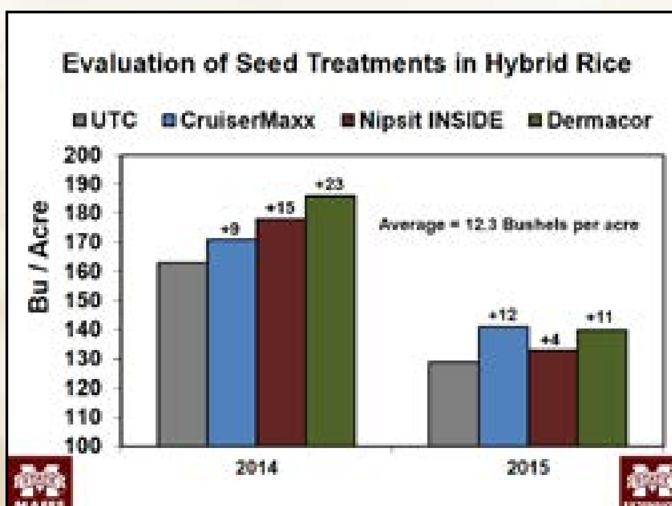
Managing rice water weevil infestations in rice has improved in recent years because of the registration of neonicotinoid seed treatments. Prior to the registration of insecticide seed treatments, the only available option to manage rice water weevil was with foliar sprays of pyrethroid insecticides. Foliar insecticide sprays can be very effective for managing rice water weevil, but proper timing is critical. The pyrethroid insecticides only provide enough residual activity to adequately control rice water weevil for 2-3 days. As a result, a poorly timed spray could result in a complete lack of control. Research in Mississippi and Arkansas has shown that seed treatments result in an overall economic benefit to growers approximately 80% of the time with an average yield advantage of 8-12 bushels of rough rice/ac. The greatest benefits from seed treatments occur when rice water weevil infestations are present and little benefit is observed in the absence of rice water weevil. Unfortunately, predicting when and where rice water weevil infestations will occur is difficult and the likelihood of having a significant infestation is high in the Mississippi Delta. Because of that, seed treatments remain an ideal management option for growers.

In addition to insecticide seed treatments, Belay was recently labeled for rice water weevil control. It is used as a foliar spray, but has some advantages over pyrethroid sprays. Most notably, Belay is a neonicotinoid that moves into the plant tissue and provides some systemic control of rice water weevil. Because of that, we have seen better residual control of rice water weevil than pyrethroids so application timing is not as critical with Belay.

Recent Research

Multiple experiments have been conducted in the Mississippi Delta to evaluate rice water weevil management with multiple tools. Appropriate scientific methods were used for all experiments.





Data has been collected from nine locations across the Delta over the last two years. Research and data collection was conducted by Andrew Adams as part of his master's research in entomology. Based on the regression equation, rice water weevil caused a loss of 0.9 bushels per acre for every larva per core.

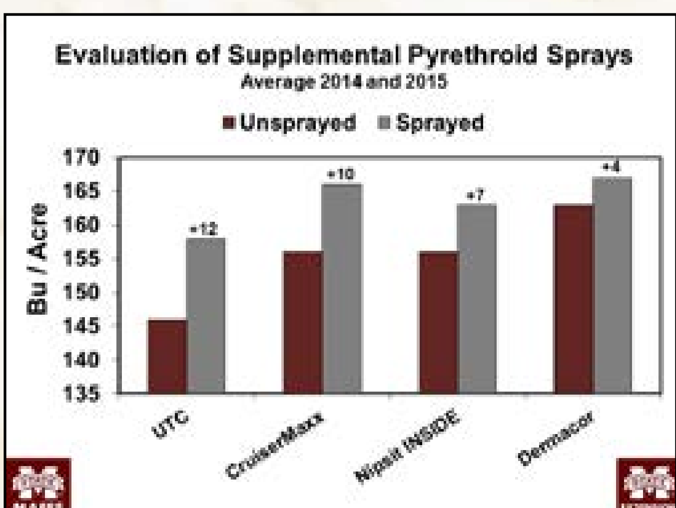
All insecticide seed treatments provided effective control of rice water weevil and significant yield benefits compared to untreated rice. Yields of rice grown with a seed treatment ranged from four to 23 bushels/ac more than yields of untreated rice. The average yield response was 12.3 bushels/ac across all seed treatments for 2014-2015.

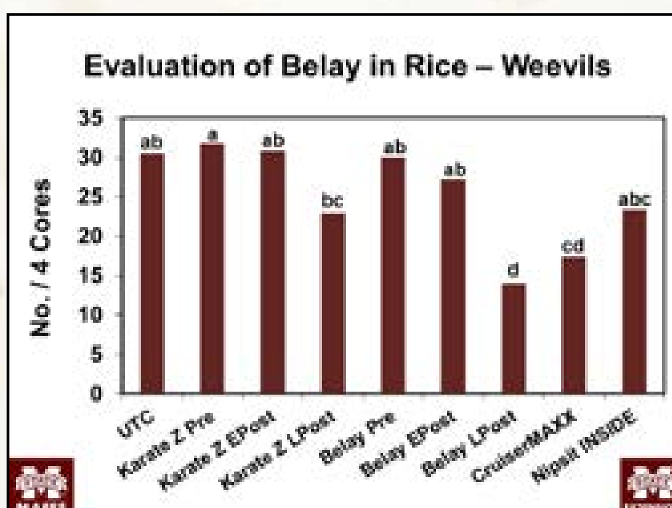
Although seed treatments provide adequate control of rice water weevil, they do not provide absolute control and supplemental sprays can provide additional benefits. Sprayed plots were sprayed with Karate Z at 2.56 fl oz/ac at flood. Rice water weevil numbers were reduced by the foliar spray in all treatments except Dermacor. Yield increases ranged from four to 10 bushels per acre for foliar sprays made following use of the seed treatments.

Pre-applications were made immediately before the field was flooded, EPost applications were sprayed within 24 hours after the flood was established, and LPost applications were sprayed seven days after the flood was established.

Rice water weevil densities were determined four weeks after flood. Belay at the LPost timing provided the best level of rice water weevil control. Spray timing was very important for both insecticides.

Based on our research across the Mississippi Delta, management of rice water weevil is very important to maximize yields. There are multiple tools currently available to manage rice water weevil. In general, seed treatments tend to provide the most consistent and effective control from location to location and year to year. As a foliar spray option, Belay tends to provide better control than pyrethroids and appears to be slightly less sensitive to application timing.

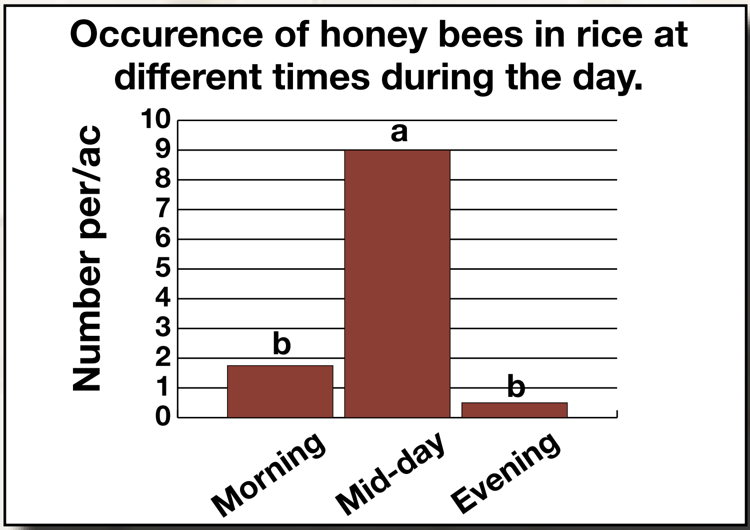




Occurrence of Honey Bees in Flowering Rice in Mississippi

Jeff Gore, Chris Dobbins, Bobby Golden, and Don Cook

Numerous insecticides are commonly used in most crops grown in the mid-south to manage various insect pests. They are an important component of managing rice water weevil, rice stink bug, and various other insects in rice. Recently, concerns have been raised about the use of insecticides in agriculture and their impact on managed honey bee colonies. In particular, the neonicotinoid class of insecticides has received the most attention. Neonicotinoids have become an important component of rice water weevil management in rice. Thiamethoxam (Cruiser) and clothianidin (Nipsit) are used as seed treatments and clothianidin (Belay) is used as a foliar spray. They consistently provide superior control of this pest compared to the only other alternative, pyrethroids. Rice is a self-pollinated crop and does not require pollination by insects to achieve adequate yields. However, many pollinators including honey bees harvest pollen from multiple plant hosts. Currently, little information exists about the occurrence of honey bees in flowering rice. A survey was conducted during the summer of 2015 to determine the occurrence of honey bees in rice throughout Mississippi. A total of eight fields were sampled three times per day with three replications per sample at four distances within rice fields. This totaled 288 total observations. A sample consisted of slowly walking 100 ft and observing an 8ft wide area (800 square feet).



Honey bees were observed in 12 of the 288 observations (4%). A total of twenty bees were observed in rice fields in Mississippi which would equate to 1089 bees per acre over all samples. More bees were observed at mid-day compared to morning and evening. Additionally, the majority of bees were observed at one location that had a bee yard with approximately twenty hives nearby. This survey showed that honey bees will visit rice during the flowering stage. However, numbers were extremely low which would suggest that the risk of insecticide applications in rice to manage pests will pose little risk to honey bee populations.

Evaluation of Dimilin in Rice

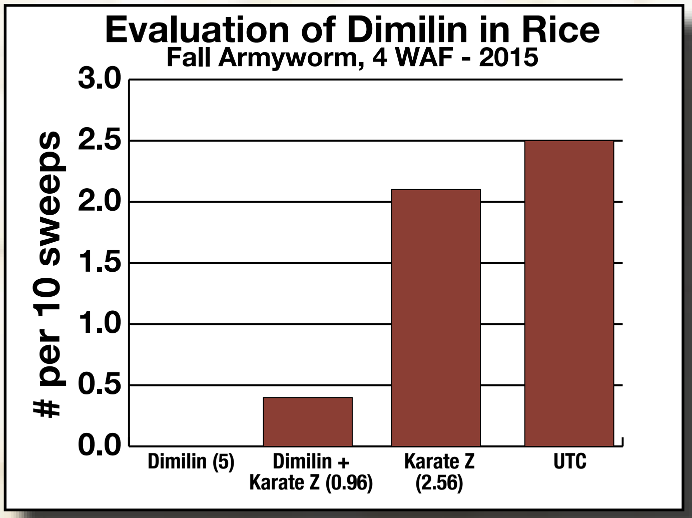
Jeff Gore, Chris Dobbins, Don Cook, and Bobby Golden

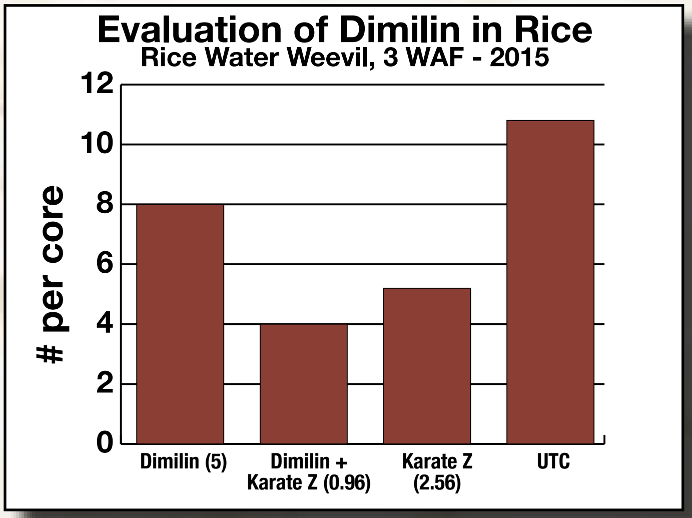
Dimilin (diflubenzuron) is an insect growth regulator that is labeled for insect control in numerous crops. Because it is an insect growth regulator, it only has activity against immature stages of insects. It is primarily used to manage various caterpillar pests, but has been shown to sterilize the adults and eggs of other insect groups. Most notably, this insecticide is known to cause sterility in several weevil species including the boll weevil and rice water weevil. During the 2014 season, fall armyworm was a serious pest of several rice fields across the mid-south. Dimilin was used in a few cases and appeared to provide long residual control. However, no data exists to confirm the level of control of fall armyworm in rice.

An experiment was conducted at the Delta Research and Extension Center in 2015 to determine the benefits of using Dimilin at the time of flood to manage both rice water weevil and fall armyworm. This test was conducted on late planted rice to maximize the chances of having a significant infestation of fall armyworm. Treatments were sprayed with a hand-boom immediately after the flood was established. Rice water weevil and fall armyworm densities were measured weekly. Rice water weevil densities were measured by taking four cores per plot. Fall armyworm densities were determined by taking 10 sweeps per plot. Yields were measured at the end of the year.

Overall, fall armyworm densities were relatively low in this trial. Densities peaked at four weeks after flood. Treatments that included Dimilin had significantly fewer fall armyworms compared to plots that did not receive Dimilin. In terms of rice water weevil, application of Dimilin alone resulted in a slight reduction in numbers of larvae. Treatments that included a pyrethroid (Karate Z) had the lowest densities of rice water weevil larvae.

In conclusion, Dimilin appears to have a good fit for insect control in rice, especially in later planted rice where there is a greater threat of having a significant fall armyworm infestation. At the rate used, Dimilin did not provide adequate control of rice water weevil and does not appear to be a stand-alone treatment for rice water weevil.





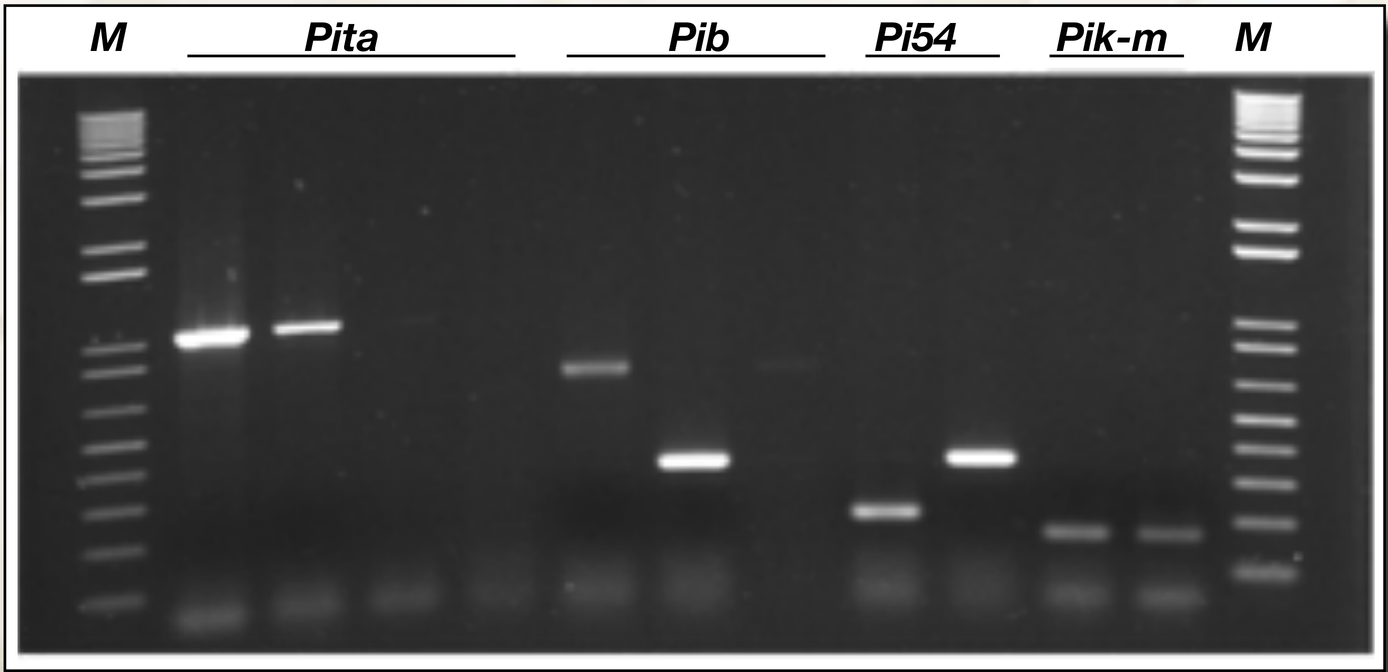
Analysis of Rice Blast Resistance Genes in Mississippi Rice Varieties

Yadong Zhang, Loida Perez, Shihai Xing, Ed Redoña, and Zhaohua Peng

Blast, caused by the fungus Magnaporthe oryzae, is one of the most critical diseases in rice in the US. Recently, severe blast incidence has occurred in Mississippi and the mid-south due to the limited disease resistance among existing varieties as well the emergence of new blast races that rapidly overcome the resistance genes present in released cultivars. Continuous use of chemicals to manage the disease may cause negative environmental impacts in addition to increasing cost of production. Host plant resistance through effective blast resistance genes remain the most sustainable approach to control the disease.

Profiling of blast resistance genes available in a breeding program is a critical step for host resistance breeding. Knowing which genes are possessed by both existing varieties and promising genetic donors would allow the generation of crosses and populations that would segregate for the maximum number of resistance genes while also possibly introducing new genes to widely adopted cultivars. We then conducted a DNA fingerprinting survey among 99 rice cultivars, donors, and advanced breeding lines that are actively being used in the Mississippi rice breeding program using seven blast resistance genes that have been tagged with DNA markers, including Pi-ta, Pib, Pi54, Pik-m, Piz, Pik, and Pik-s. The varieties are mainly Tropical Japonica types that possess many of the desirable traits for rice breeding in Mississippi.

DNA marker analysis showed that 78% of the active breeding materials being used in Mississippi have at least one or a combination of 2-4 genes in their genetic background. Most of the varieties have Pik-m (36.4%), followed by Pik (31.3%) and Pi54 (23.2%). Pib and Piz were reported to be effective to control the emerging and devastating rice blast race IE-1k in the southern US. Our results showed that nine varieties harbor Pib and/or Piz in its genetic background.

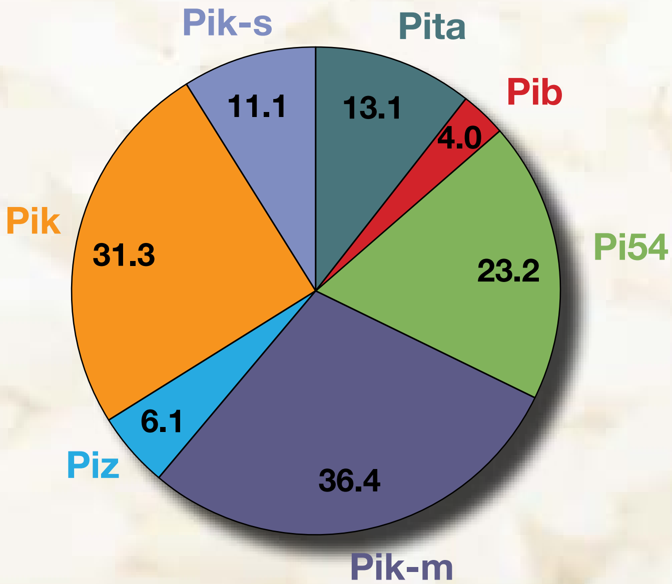


The released variety Jupiter has Piz while JES has both Piz and Pib in addition to Pi54 and Pik. Ten varieties have at least 3-4 resistance gene combinations while only three varieties have four resistance genes including two released varieties, Katy and JES, and one donor variety GSOR 100472. JES is a good variety since it has both Pib and Piz known to be effective against two major blast races, IB1 and IC17. Together with the other breeding lines and donor parents, these varieties can be sources of resistance to combat race IE-1k and reduce losses in southern rice fields.

There are only four varieties in the population surveyed that have Pib: RU1304156, RU1305001, RU1402131, and JES. In order to get the combinations of most resistant genes, the suggested parents to develop F1 crosses include JES (with Pib, Pi54, Piz, Pik) and Katy (with Pi-ta, Pi54, Pik-m, Pik-s). Piz and Pib seems to work with rice blast strains in southern varieties.

To get the two genes together, the suggested parent combinations are: 1) JES/GSOR 100472 - this will combine Piz and Pib plus other genes that could interact and enhance durable resistance to blast; and 2) GSOR100417/JES - GSOR100417 has Piz and Pi54 while JES has Pib, Pi54, Piz, Pik. This combination will combine Piz and Pib with the increased probability of getting lines with homozygous Piz and Pi54 since both parents have the two genes together.

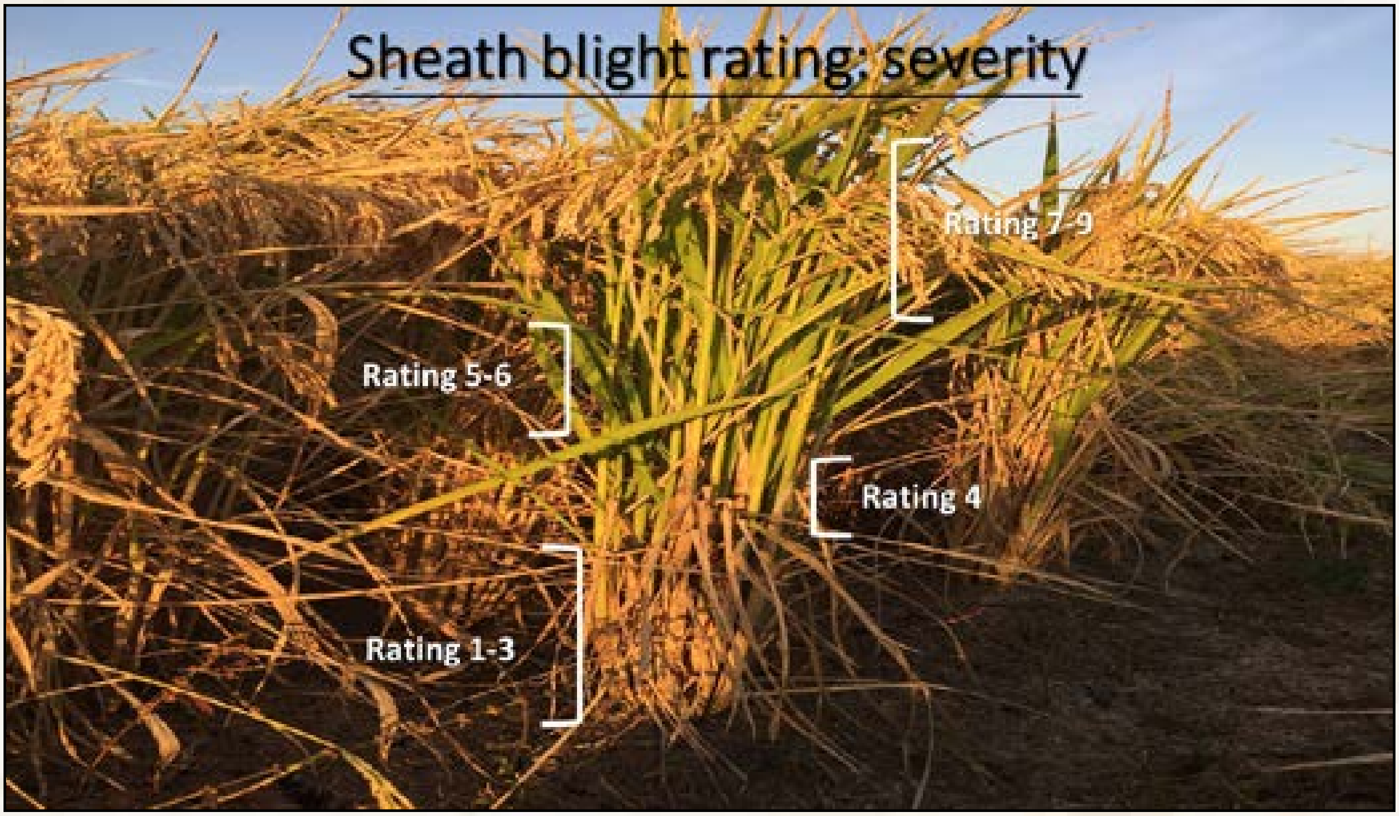
Although Pi-ta confers resistance to a broad spectrum of rice blast races for many years, there is a need to explore new gene(s) and gene combinations in order to improve disease resistance because of the emergence of new blast strains in the field. Mapping of novel blast R genes, development of marker sets (for foreground and background selection) will enhance efficiency and precision of breeding resistant varieties for Mississippi rice producers.



(facing page) DNA fingerprints of Pi-ta, Pib, Pi54, and Pik-m in selected Mississippi rice varieties using blast R genes associated molecular markers, and (left) Distribution of blast R genes in active breeding lines being used for rice breeding in Mississippi (n=99).

Plant Pathology Program: Sheath Blight Management

Tom Allen

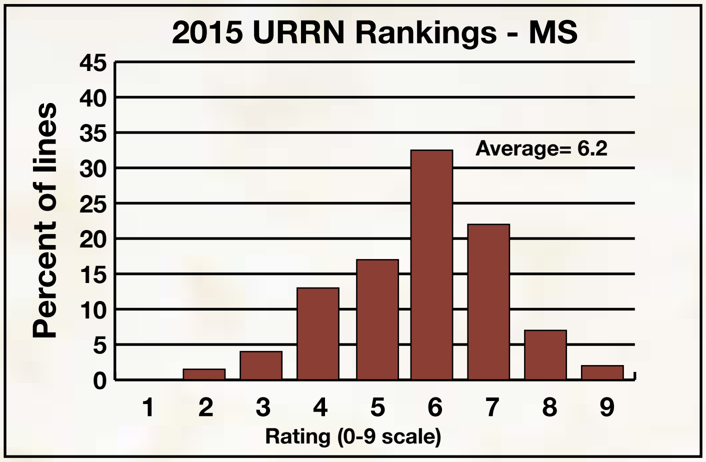


Modified 0 to 9 rating scale used to rate sheath blight. Sheath blight ratings are conducted from the ground to the top of the plant.

Sheath blight is one of the single most important diseases of rice. Even though all of the commercially available cultivars are susceptible to the disease, breeding efforts are underway to combat this disease. In the meantime, trials are conducted on an annual basis to provide information to breeders on the susceptibility of rice entries contained in the Uniform Regional Rice Nursery (URRN) to the sheath blight fungus. In addition, fungicide trials with new products compared with some of the older chemistries are annually conducted to determine the efficacy of commercially available fungicides.

In general, the URRN contains approximately 200 rice entries that at some point in the future may become new rice cultivars depending on their performance across the rice growing region over multiple years. In Mississippi, the entries contained in the URRN are inoculated with Rhizoctonia solani, the sheath blight fungus, and observed for their response. Single row “plots” were planted and inoculated with a slurry of the fungus shortly after permanent flood establishment. The inoculated plots are rated towards the end of the season, after heads have emerged. Sheath blight severity is rated using a modified 0 to 9 scale. Rice plants are observed for their response to sheath blight from the base of the plant at the soil line to the top of the plant using a 0 to 9 scale whereby 0=no disease and 9=a completely diseased, lodged plant. The photo included depicts the general rating scale used to determine sheath blight severity as it moves up the plant.

In general, during 2015, a range of severities were observed within the entries. The lowest severity observed was a 2 in two entries, and the greatest severity, a 9, was observed in three entries. On average, the response of the URRN entries in Mississippi was a 6. However, some entries were observed to have sheath blight lower in the canopy suggesting that there is some inherent tolerance to the disease in at least 37% of the entries observed during 2015.



In addition to observing entries for their response to sheath blight in the URRN, new fungicide products are screened for their efficacy in managing sheath blight. Fungicide trials were conducted during 2015; however, due to a severe herbicide drift issue that greatly reduced the photosynthetic leaf surface trial results from 2014 are presented. Applications were made between the early and late boot timings. Over the past few years two new fungicides have become available for rice farmers. One of those fungicides is a new strobilurin-based fungicide that contains azoxystrobin, the active ingredient in Quadris, which is available from Cheminova and called Equation. The other new fungicides for rice farmers is Sercadis (active ingredient- fluxapyroxad). Since the identification of strobilurin-resistant sheath blight in Louisiana in 2011, Sercadis has been widely marketed to specifically manage strobilurin-resistant sheath blight. The mode of action of fluxapyroxad is different than the strobilurins (e.g., Quadris) as well as the triazoles (e.g., Tilt) and offers an additional active ingredient to manage sheath blight and reduce the potential for resistance to develop. At present, resistance to the strobilurin fungicides has not been detected in isolates of the sheath blight fungus from Mississippi.

Results from foliar fungicide trials conducted during 2014 on Cocodrie to consider the efficacy of Sercadis and Sercadis-based applications on sheath blight rice in inoculated trials.

	Yield (bu/ac)	
Nontreated	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 250EC 17.5 fl oz/a	147.4	abc
Tilt 10 fl oz/a	142.5	bcd
	CV	7.5
	p-value	0.0422
	LSD	17.2
	St. Dev.	13.4

Results from foliar fungicide trials conducted during 2014 on Cocodrie to consider the efficacy of Equation on sheath blight in inoculated trials.

	Yield (bu/ac)	
Nontreated	138.8	
Equation 9 fl oz/a	145.3	
Equation 12.5 fl oz/a	129.8	
Quadris 12.5 fl oz/a	143.3	
Tilt 10 fl oz/a	141.7	
Quilt Xcel 14 fl oz/a	143.6	
Stratego 17.5 fl oz/a	144.8	
	CV	9.4
	p-value	0.2713
	LSD	19.6
	St. Dev.	14.5

Summary of Weed Control in Mississippi Rice for 2015

Jason Bond, Matthew Edwards, Bobby Golden, Ben Lawrence, and Tyler Hydrick

The 2016 Mississippi State University Rice Planning Budget (Budget Report 2015-04) allocates $125 to $150 per acre for herbicides, making weed control one of the single greatest expenses in rice production. Reports of poor herbicide efficacy and rice injury were common in Mississippi rice during 2015. The majority of these problems were directly or indirectly caused by poor environmental conditions during April and May. Although it did not affect large acreage in Mississippi, one problem was injury from Newpath on the Clearfield rice hybrid CLXL745. In most cases, injury appeared when applications were completed shortly before or after extreme rainfall events. Stress from the poor growing environment likely reduced the hybrid's ability to metabolize the herbicide; therefore, an unusual level of injury was observed.

Approximately 95% of rice in Mississippi is grown in a 1:1 or 1:2 rotation with soybean. Although crop rotation is a primary method to manage herbicide resistance, this issue is a growing problem for Mississippi rice growers. One barnyardgrass population from Sunflower County exhibits multiple resistance to ACCase, ALS, synthetic auxin, and photosystem II herbicides. Other populations exhibit multiple resistance to combinations of herbicides in these families. Resistance to ALS herbicides in rice flatsedge is a widespread problem in Mississippi rice, and ALS herbicides are no longer recommended for application on this species. Lastly, ALS resistance in red rice from Mississippi was confirmed through genetic testing in 2015.

Herbicide drift is a perennial problem for rice growers. Mississippi State University Extension Service recommendations suggest application of the nonselective herbicide paraquat mixed with a residual herbicide to control glyphosate-resistant weeds

Typical drift of paraquat plus Boundary on rice (detail shot on the left, overall field on the right).

prior to planting corn, cotton, or soybean. Rice is often grown in close proximity to these crops, and cases of paraquat drift to rice have in-creased in Mississippi. Research at the Delta Research and Extension Center in 2015 showed that injury following exposure to paraquat at 10% of the labeled use rate was least with applications at panicle differentiation. However, rice exposed to paraquat at panicle differentiation never matured. Therefore, the full extent of the consequences of paraquat drift at midseason may not be apparent until much later in the growing season.

The weed management program at the Delta Research and Extension Center annually evaluates experimental herbicides and new premixes of older herbicides for their potential in rice. One currently under evaluation is a new herbicide-resistant technology from BASF that will be market-ed as Provisia. The Provisia technology is a non-GMO herbicide resistance trait similar to the Clearfield technology. It allows postemergence application of an ACCase herbicide not previously labeled for rice. The herbicide currently under evaluation is quizalofop, which will be marketed as Provisia herbicide.

Provisia is extremely effective for red rice control. Two applications of Provisia at 15 oz/ac provided complete control of red rice and volunteer hybrid rice in 2015. In 2014, red rice control 14 days after early-postemergence applications was reduced when Facet L, RiceBeaux, or Permit Plus were added to Provisia. However, red rice control was similar among all herbicide treatments 14 days after early-postemergence applications in 2015. Tank mixtures with Provisia will likely be restricted with fewer options than currently available in a Clearfield rice weed control system.

Drift of paraquat plus Authority MTZ on rice.

Severe infestation of barnyardgrass in rice.

Effect of Rice Herbicides on Soybean with BOLT™ Technology

Jason Bond, Matthew Edwards, Jimmy Peeples, Ben Lawrence, Tyler Hydrick, and Tameka Phillips

Acetolactate synthase (ALS)-inhibiting herbicides are utilized for control of annual and perennial broadleaf weeds and sedges in rice and soybean in Mississippi. Although ALS herbicide are commonly used in both soybean and rice, none of the ALS herbicides used in conventional rice are labeled for soybean. Soybean are susceptible to herbicide drift from rice because these crops are often grown in close proximity.

In 2015, DuPont Pioneer released a new soybean herbicide resistance trait that will be marketed as BOLT™. The BOLT technology enhances soybean tolerance to sulfonylurea herbicides and possibly to other ALS herbicides. If injury to BOLT cultivars from ALS herbicides used in rice was less than that on soybean cultivars without the BOLT technology, the new cultivars could be utilized adjacent to rice fields to mitigate the effect of spray drift from rice herbicide applications. Research was conducted at Mississippi State University's Delta Research and Extension Center in Stoneville, MS, to compare the response of Roundup Ready, STS, and BOLT soybean cultivars to low rates of ALS herbicides common in southern U.S. rice production.

Four soybean cultivars were treated with low rates of common ALS rice herbicides when the majority of soybean plants in each plot had one to two fully expanded trifoliate leaves. Soybean cultivars included 'Pioneer P49T09BR' and 'Pioneer P50T15R" (BOLT cultivars), 'Asgrow AG4632' (STS cultivar) and 'Pioneer P95Y10' (Roundup Ready cultivar). Herbicide treatments were applied at 12.5% of the labeled rates of League (3.2 ounces/ac), Permit Plus (0.75 ounces/ac), Regiment (0.67 ounces/ac), and Strada Pro (2.5 ounces/ac).

Pioneer 95Y10 was injured more than BOLT cultivars with each herbicide 7, 14, and 28 days after treatment (DAT). Although the magnitude was >40%, Permit Plus injured Pioneer 95Y10 less than other herbicides 14 and 28 DAT. Injury to Pioneer 95Y10 and Asgrow 4632 was similar with Regiment 7, 14, and 28 DAT, and the level of injury was greater than that exhibited by the BOLT cultivars. Regiment injured Asgrow 4632 and both BOLT cultivars more than other herbicides at all evaluations. Asgrow 4632 was injured more with Strada Pro 7 DAT than the BOLT cultivars; however, the response of Asgrow 4632 to League, Permit Plus, and Strada Pro was similar to Pioneer 50T15R 14 and 28 DAT. Injury to Pioneer 49T09BR was greater than that for Asgrow 4632 and Pioneer 50T15BR with Strada Pro 14 DAT. Problematically, the response to some of the herbicides evaluated in the current research varied between the BOLT cultivars. Injury to Pioneer 49T09BR with Regiment was greater than that for Pioneer 50T15R at all evaluations. The same trend was observed with Strada Pro 14 DAT.

Roundup Ready, STS, and BOLT soybean cultivars responded differently to ALS herbicides used in southern U.S. rice. The STS cultivar Asgrow 4632 was as tolerant as the BOLT cultivar Pioneer 50T15R following applications League, Permit Plus, and Strada Pro applied at 12.5% of labeled rates. Among the four cultivars evaluated, response to Regiment was most variable with injury ranging from 23 to 85% 28 DAT. Although it was not completely tolerant to all herbicides evaluated, Pioneer 50T15R could be planted adjacent to rice fields and lessen the potential negative effects from drift of ALS herbicides.

Rice Performance Following Off-target Herbicide Movement

Jason Bond, Matthew Edwards, Jimmy Peeples, Ben Lawrence, Tyler Hydrick, and Tameka Phillips

In Mississippi, rice is commonly grown adjacent to corn, cotton, and soybean. Glyphosate-resistant weeds, primarily glyphosate-resistant Palmer amaranth, are the principal weed control issue facing growers in Mississippi. Residual herbicide applications prior to planting for glyphosate-resistant weed control have been widely adopted in cotton, corn, and soybean; however, these applications often include paraquat and injury symptoms can be complex and difficult to identify. Research was conducted in 2015 at the Mississippi State University Delta Research and Extension Center to characterize the rice response to exposure to a sublethal rate of Gramoxone SL applied in mixtures with different residual herbicides.


Nontreated


Gramoxone SL


Gramoxone SL + Fierce


Gramoxone SL + Lexar EZ

Herbicide treatments were applied at 10% of the rates recommended for application in Mississippi. They included Gramoxone SL at 0.3 pints/acre alone and in mixtures with Authority MTZ at 1.8 ounces/acre, Boundary at 0.25 pints/acre, Canopy at 0.1 ounces/acre, Corvus at 0.56 ounces/acre, Cotoran at 0.2 pints/acre, Envive 0.4 ounces/acre, Fierce at 0.375 ounces/acre, Lexar EZ at 0.3 quarts/acre, Prefix 0.2 pints/acre, and Sonic 0.645 ounces/acre. Treatments were applied to rice in the two- to three-leaf growth stage. Visual estimates of rice injury were recorded 3, 7, 14, 21, and 28 days after treatment (DAT), and rice height was recorded 14 DAT. The number of days to 50% heading was recorded as an indication of rice maturity. Rice lodging severity was visually estimated at maturity.

At 7, 14, and 28 DAT, the greatest rice injury was observed following Gramoxone SL plus Lexar EZ. Gramoxone SL plus Authority MTZ, Boundary, or Cotoran caused less injury than Gramoxone SL plus Lexar EZ 7 DAT; however, injury was still ≥ 51% with these treatments. Injury was 41% with Gramoxone SL alone 14 DAT, and this level of injury was similar to that from mixtures of Gramoxone SL with Canopy, Fierce, or Prefix. All other herbicide mixtures except Gramoxone SL plus Lexar EZ injured rice 50 to 54% 14 DAT. Gramoxone SL plus Corvus injured rice 76% 28 DAT, but this was less than injury observed with Gramoxone SL plus Lexar EZ. Injury to rice with mixtures of Gramoxone SL plus Prefix or Fierce was comparable to Gramoxone SL alone 28 DAT. All treatments delayed maturity ≥ 11 d; however, Gramoxone SL plus Lexar EZ delayed maturity 15 d compared with the nontreated control. Rice height and lodging severity estimations were similar following application of all herbicide mixtures.

Injury was greatest when Gramoxone SL was mixed with residual herbicides representing Group 27 (HPPD inhibitors) compared with herbicides in other groups. Injury was still ≥ XX% 28 DAT and maturity was delayed ≥ 11 d; therefore, applications of Gramoxone SL plus residual herbicides to fields in proximity to rice should be avoided if conditions are conducive for off-target movement.

Rice On-Farm Variety Trials in Mississippi

Ed Redoña, Paxton Fitts, Whitney Smith, Zach Dickey, Jennifer Corbin, Scott Lanford, Graham Hollister, and Bobby Golden

On-farm rice variety trials for 2015 were conducted at seven locations from north to south in the Mississippi Delta: Tunica, Clarksdale, Ruleville, Shaw, Choctaw, Stoneville, and Hollandale. Average yield across sites was 220 bu/ac, with Hollandale and Tunica being the highest and lowest yielding sites, respectively. In all, 29 varieties, hybrids and advanced breeding lines were tested including nine Clearfield® types. The hybrid XL753 was the highest yielder across locations and among all hybrids. For conventional varieties, the top-yielders were Lakast, Rex, and a new breeding line RU1404154. For conventional Clearfield® types, a new medium grain test entry CLMedium gave the highest yield which was greater than that of CL151. The upcoming variety release RU1104077 (tentatively named Thad) was the fourth highest yielding conventional variety tested, outperforming other established varieties such as Mermentau, Cocodrie, Cheniere, Taggart, Bowman, Sabine, and RoyJ.

To assist Mississippi rice producers in their 2016 variety selection and seed ordering processes, preliminary results of the 2015 variety trials were made available at the following sites as early as October 1, 2015: (1) Mississippi Crops website: http://www.

RU1104077, an MSU developed elite breeding line entered in the on-farm variety trial that is in the final stages of the variety release process.

mississippi-crops.com/2015/10/01/2015-rice-on-farm-variety-trial-preliminary-data/; and (2) MAFES website: http://www.mafes.msstate.edu/variety-trials/docs/rice/all_locations_2015.pdf. The regular MAFES printed information bulletin containing the detailed results of the variety trials and other related information will be published in early 2016.

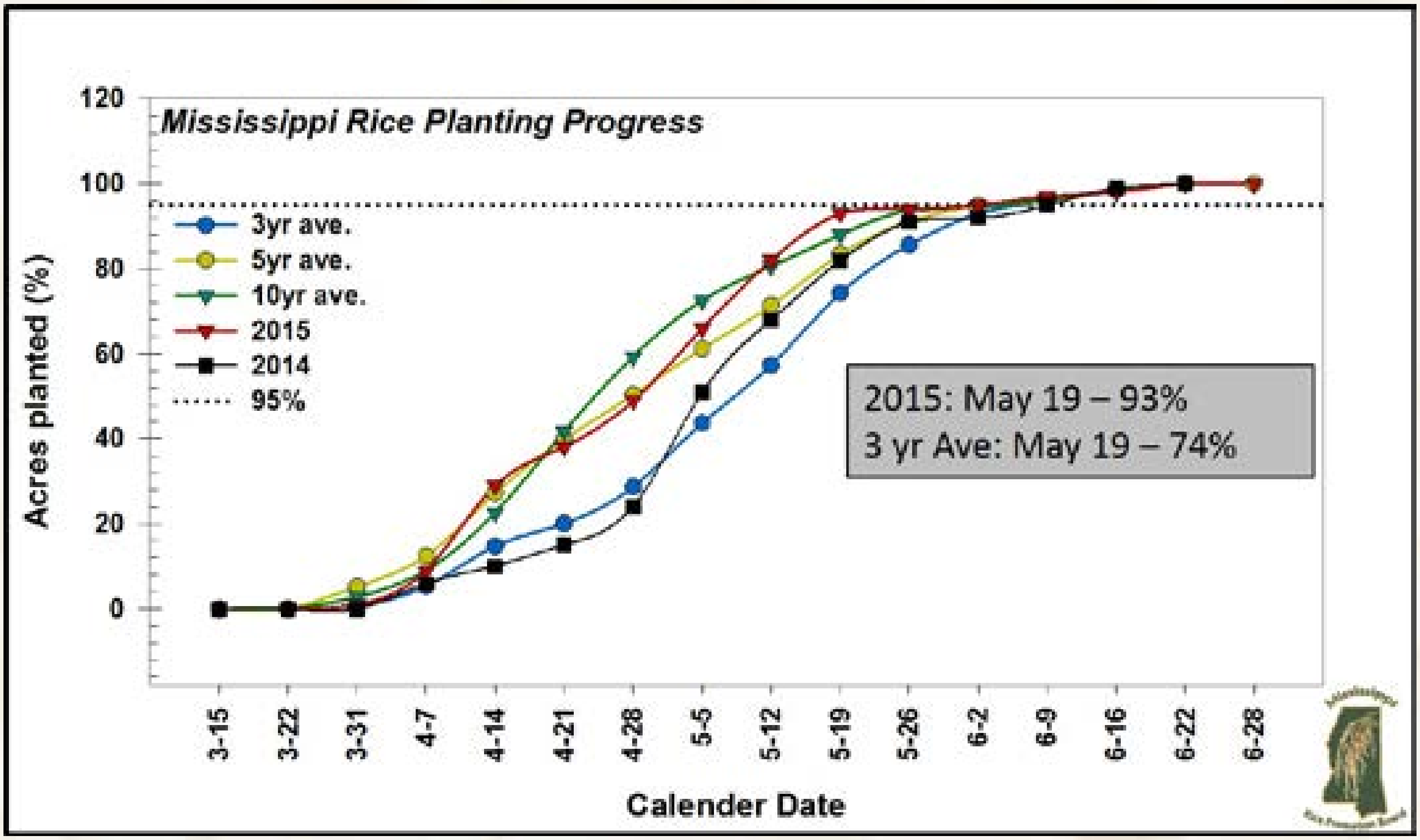
Average rough rice yields of varieties, hybrids, and advanced breeding lines evaluated in on-farm trials at seven Mississippi locations, 2015.

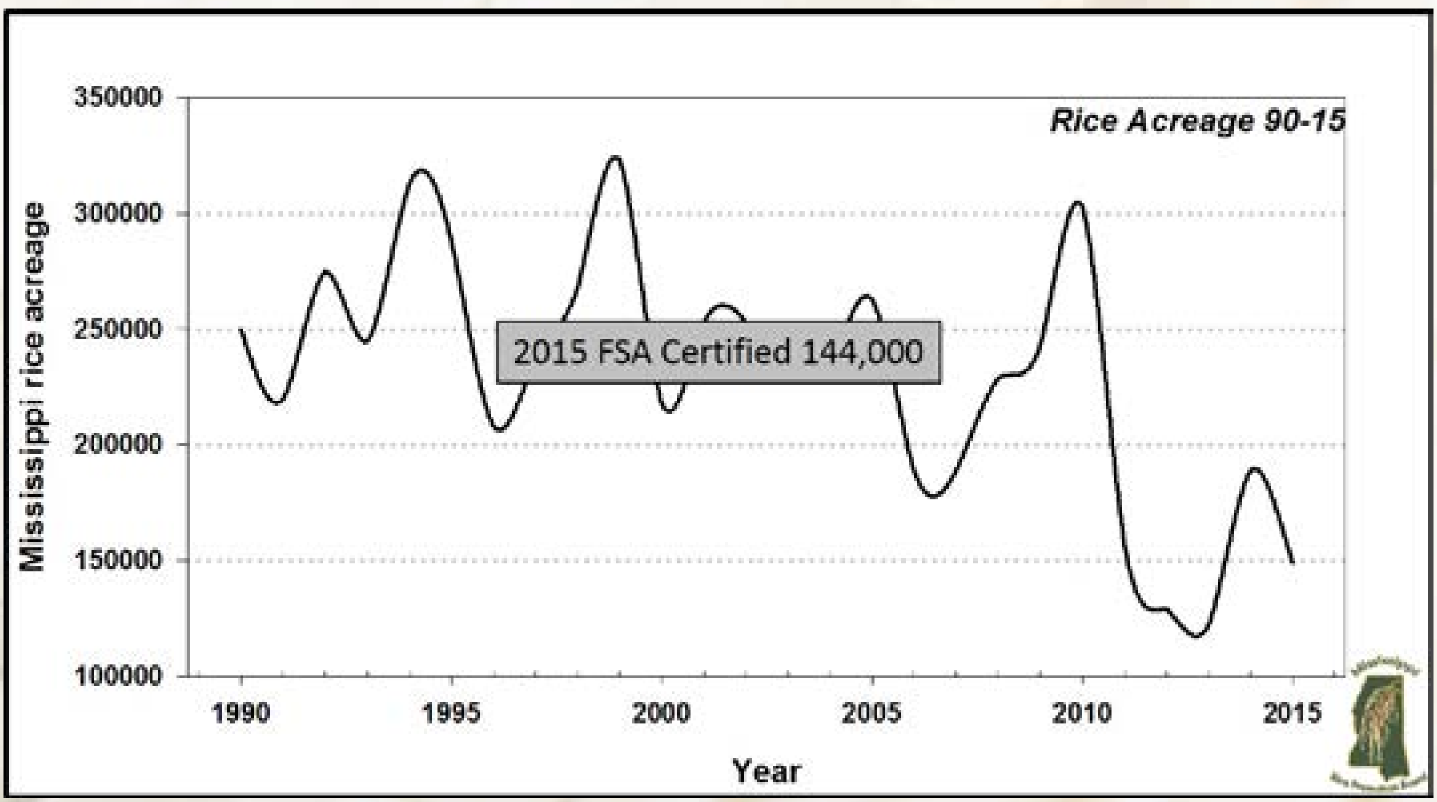
Entry	Choctaw	Clarksdale	Ruleville	Hollandale	Shaw	Stoneville	Tunica	Average	Stability[1]
	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	bu/A	
					Conventional				
Antonio	256.3	226.7	212.0	266.2	212.0	151.5	174.8	214	19
Bowman	216.5	216.2	221.3	236.4	146.8	179.9	127.9	192	22
Cheniere	237.8	201.2	215.8	240.7	200.8	174.9	172.3	206	13
Cocodrie	255.2	218.7	216.7	269.9	201.3	160.4	173.7	214	19
LaKast	280.7	252.2	250.1	288.2	248.6	189.4	209.0	245	15
Mermentau	227.8	197.8	192.8	237.0	200.3	182.8	176.1	202	11
Rex	254.9	241.6	250.8	279.7	236.8	193.3	209.4	238	12
RoyJ	233.1	195.8	214.1	228.9	111.7	142.7	82.0	173	35
Sabine	215.5	183.2	193.8	225.2	162.6	133.6	132.8	178	21
Taggart	282.6	237.7	232.0	261.5	212.4	201.5	92.0	217	28
RU1104077	256.3	241.0	258.4	259.4	171.5	195.2	154.4	219	20
XL753	243.5	247.9	323.8	356.3	260.5	201.8	290.7	275	19
XL760	295.7	280.4	300.1	348.1	247.4	229.9	187.7	270	20
RU1304154	252.5	207.6	206.7	277.2	214.6	166.8	164.5	213	19
RU1204197	252.0	224.3	202.4	274.7	208.0	149.3	187.9	214	19
RU1404122	232.8	236.8	256.9	281.2	205.3	192.8	207.0	230	14
RU1404154	241.4	240.0	237.6	263.9	225.9	220.3	195.2	232	9
RU1404156	230.6	230.5	247.5	263.2	202.1	171.5	169.3	216	17
RU1404194	235.9	231.0	195.7	251.7	182.0	162.5	60.4	188	34
RU1404198	242.8	211.9	244.8	277.2	180.2	178.0	122.4	208	25
					Clearfield				
CL111	243.1	210.3	231.4	237.5	212.5	147.9	184.1	210	16
CL151	237.9	228.4	250.1	282.4	223.1	191.0	196.8	230	14
CL152	241.2	219.4	216.5	225.3	214.6	190.3	162.5	210	12
CL172	231.7	232.0	240.8	241.0	197.6	168.5	131.2	206	21
CLMedium	256.9	253.8	257.9	269.2	215.0	181.0	188.9	232	16
CLXL729	279.9	281.6	294.9	325.2	270.7	169.3	234.7	265	19
CLXL745	233.7	253.7	287.6	351.3	231.3	176.1	232.8	252	22
CLx2134	263.6	239.5	233.3	280.4	231.6	183.0	191.6	232	15
RU1204156	224.5	218.7	205.3	224.7	200.1	188.8	134.8	200	16
Mean	247	230	238	270	208	178	171	220	
LSD	36	35	22	27	23	25	38	26	
CV	8.9	9.3	5.6	6.2	6.6	8.4	13.7	19.4	
Planting Date	March 31	April 9	April 8	March 31	April 30	May 6	May 4		
Emergence date	April 11-15	April 19-23	April 17-21	April 10-13	May 5-10	May 12-17	May 10-15		

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.

Rice Acreage and Planting Progress

Bobby Golden





The Delta Agricultural Weather Center Provides On-site Weather Data for MSU Rice Variety Trials

Mark Silva

Agricultural weather data are needed by rice producers, researchers, and policy makers to make decisions daily. Producers utilize the data for critical management decisions about tillage, planting, crop protection applications, flooding, fertilization, and harvesting. Researchers require agriculture weather data to analyze test products, verify field data, and compare different data sets to each other. Mobile weather stations were installed at three sites that are being used by the breeding program for conducting yield trials, including on-farm testing. The weather data collected will help in understanding rice yield potential as affected by climatic factors under Mississippi conditions. Moreover, the setup may be expanded in the future to cover all on-farm test locations in order to gain a deeper understanding of genotype X environment interaction effects for yield and key traits for use in both breeding widely adapted cultivars and location-specific variety deployment.

NOTES