



2019 University of Arkansas Rice Research Verification Program

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RICE RESEARCH VERIFICATION PROGRAM, 2019

Conducted by:

Ralph Mazzanti, Program Associate – RRVP

Ron Baker, Program Associate – RRVP

Dr. Jarrod Hardke, Associate Professor and Rice Extension Agronomist

Dr. Brad Watkins, Professor – Agricultural Economics

Acknowledgments:

Cooperating Rice Producers:

Bohanan Ag

Brad Burkett

Cornerstone Farms

Stan Haigwood

Joe & Tori Hicks

Robert Johnson

Tad Keller

Darrow Linn

Curtis Nash

Ethan Puritt

Brett Stewart

Anthony & Shaun Smith

Curtis Tate

Thaxton Brothers

Mark & Ben Throesch

Cooperating County Extension Agents:

Mike Andrews – Randolph County

Bryce Baldrige – Lawrence County

Stan Baker – Lee County

Grant Beckwith – Arkansas County

Maxx Coffin – Lonoke County

John Farabough – Desha County

Matthew Davis – Jackson County

Clay Gibson – Chicot County

Brett Gordon – Woodruff County

Chris Grimes – Craighead County

Phil Horton – Arkansas County

Russell Parker – Crittenden County

Keith Perkins – Lonoke County

Steven Stone – Lincoln County

Kurt Beaty – Jefferson County

Jan Yingling – White County

Cooperative Extension Service:

Dr. Rick Cartwright, Associate Vice President, Agriculture and Extension

Beth Phelps, Ouachita District Director

Jerry Clemons, Delta District Director

Dr. Tom Barber, Extension Weed Scientist

Dr. Nick Bateman, Extension Entomologist

Dr. Tommy Butts, Extension Weed Scientist

Dr. Gus Lorenz, Extension Entomologist

Dr. Yeshi Wamishe, Extension Plant Pathologist

Agricultural Experiment Station:

Dr. Robert Bacon, Professor and Dept. Head – Crop, Soil, and Environmental Sciences

Dr. Paul Counce, Professor – Crop, Soil, and Environmental Sciences

Donna Frizzell, Program Associate – Crop, Soil, and Environmental Sciences

Dr. Karen Moldenhauer, Professor – Crop, Soil, and Environmental Sciences

Dr. Richard Norman, Professor – Crop, Soil, and Environmental Sciences

Dr. Trenton Roberts, Associate Professor – Crop, Soil, and Environmental Sciences

Dr. Bob Scott, Director – Rice Research and Extension Center

Dr. Terry Siebenmorgen, Professor – Food Science

Dr. Nathan Slaton, Professor – Crop, Soil, and Environmental Sciences

Arkansas Rice Research and Promotion Board:

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Rich Hillman

Roger Pohlner (Vice Chairman)

Bryan Moery

Joe Christian (Secretary/Treasurer)

Jim Whitaker

David Gairhan

Wayne Wiggins

Marvin Hare

INTRODUCTION

The 2019 growing season was the thirty-sixth year for the Rice Research Verification Program (RRVP). The RRVP is an interdisciplinary effort between growers, county extension agents, extension specialists, and researchers. The RRVP is an on-farm demonstration of all the research-based recommendations developed by the University of Arkansas System Division Of Agriculture for the purpose of increasing the profitability of rice production in Arkansas. The specific objectives of the program are:

1. To demonstrate and verify research-based recommendations for profitable rice production throughout the rice-producing areas of Arkansas.
2. To develop a database for economic analysis of all aspects of rice production.
3. To demonstrate the benefits of available technology and inputs for the economic production of consistently high rice yields.
4. To identify specific problems and opportunities in Arkansas rice for further investigation.
5. To promote timely implementation of management practices among rice growers.
6. To provide training and assistance to county agents and growers with limited expertise in rice production.

The RRVP fields and cooperators are selected prior to planting. Cooperators agreed to pay production expenses, provide crop expense data for economic analysis, and implement the recommended production practices in a timely manner from seedbed preparation to harvest. Fifteen fields were enrolled in the RRVP in 2019. The fields were located on commercial farms ranging in size from 18 to 107 acres. The average field size was 55 acres.

Counties participating in the program during 2019 included Arkansas, Chicot, Craighead, Crittenden, Desha, Jackson, Jefferson, Lawrence, Lee, Lincoln, Lonoke, Monroe, Randolph, White and Woodruff (Figure 1).

The fifteen rice fields totaled 830 acres enrolled in the program. Five different cultivars were seeded: (Diamond [6 fields]; RiceTec [RT] XP753 [5 fields]; RT Gemini 214 CL [2 fields]; RT CLXP4534 [1 field]; RT CLXL745 [1 field]). University of Arkansas System Division of Agriculture Cooperative Extension Service recommendations were used to manage the RRVP fields. Agronomic and pest management decisions were based on field history, soil test results, rice cultivar, observations, and data collected from individual fields during the growing season. An integrated pest management philosophy was utilized based on CES recommendations. Data collected included components such as stand density, weed populations, disease infestation levels, insect populations, rainfall,

irrigation amounts, and dates for specific growth stages, grain yield, milling yield, and grain quality.

Figure 1. County Locations (shaded) of 2019 Rice Research Verification Program Fields.



FIELD REVIEWS

Southern Coordinator – Ralph Mazzanti

Northern Coordinator – Ron Baker

Arkansas County

The traditionally contoured Arkansas County field was located just west of Stuttgart on Dewitt silt loam soil. The field consisted of 60 acres and the previous crop grown on the field was soybean. The variety chosen was Diamond treated with CruiserMaxx Rice seed treatment and drill seeded. The seeding rate was 75 lbs/ac planted on April 28. Emergence was observed on May 13 with a stand count of 14 plants/ft². No tillage practices were used for spring field preparation. According to the soil test a 0-50-60-10 lb/acre (N-P₂O₅-K₂O-Zn) was applied. Glyphosate, Command, and League herbicides were applied at planting on April 30. Facet was applied as a post-emergence herbicide on May 28. Using the N-STaR recommendation, N fertilizer in the form of urea plus an approved NBPT was applied at 170 lb/acre on May 29. Multiple Inlet Rice Irrigation (MIRI) was utilized to achieve a more efficient permanent flood. Midseason nitrogen as urea was applied according to GreenSeeker response index on June 26 at a rate of 100 lb/acre. An adequate flood was maintained throughout the growing season. The field was checked weekly for diseases and no fungicide application was required based on field evaluations. Rice stink bugs reached threshold levels and lambda-cyhalothrin was applied on July 3. The field was harvested on September 27 yielding 184 bu/ac and a milling yield of 52/69. The average harvest moisture was 16%. Total irrigation was 33.5 ac-in/ac and total rainfall was 21.48 in.

Chicot County

The 57-acre zero-grade row rice field was located north of Lake Village on a Perry clay soil. No spring tillage practices were utilized and soybean was the previous crop. RT Gemini 214 CL treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded on April 4 at 23 lb/acre. Preplant fertilizer of 18-46-0 lb/acre (N-P₂O₅-K₂O) was applied on April 4. Command and League herbicides were applied at planting. Field emergence was recorded on April 29 with a stand density of 6.7 plants/ft². Clearpath was applied as a post-emergence herbicide on May 23. Based on N-STaR results and current recommendations for N management in furrow-irrigated rice, N fertilizer in the form of urea plus NBPT was applied at 130 lb/acre on May 18. A second N application of 130 lb/acre was applied May 30. A third N application of 130 lb/acre was applied June 7. Intermittent flushing was maintained throughout the growing season as a practice with row rice production. Based on GreenSeeker response index during midseason growth stages, N level was sufficient. Late-boot N was applied as urea on July 15 as urea at 70 lb/acre. The field was checked weekly for diseases and based on field evaluations no fungicide application was required. Stink bugs reached threshold levels and on August 1 lambda-cyhalothrin was applied. The field was harvested September 12 with a yield of 187 bu/ac and a milling yield of 58/73. The harvest moisture was 20%. Irrigation amount totaled 36 ac-in/ac and total rainfall was 26.5 in.

Craighead County

The furrow-irrigated Craighead County field was located east of Bay. The soil classification was a combination of Mhoon and Dundee fine sandy loams and Roellen silty clay loam. The field was 68 acres and the previous crop grown was soybean. A no-till system on 38-in beds from the previous soybean crop was used. A burndown herbicide tank mix of RoundUp Pro Max plus 2,4-D and FirstShot was applied in the spring prior to planting. Based on soil test analysis, a pre-plant fertilizer was applied at 16-42-120 lb/acre (N-P₂O₅-K₂O). The hybrid RT XP753 with the company's standard seed treatment including NipsIt INSIDE insecticide was drill-seeded at 25 lb/acre on April 30. A pre-emergence tank mix of Command and Facet L was applied on May 3. Rice emergence was observed on May 15 with a stand count of 5.7 plants/ft². An overlapping residual herbicide tank mix application of Prowl H₂O and Command was made on May 27 providing good control of weeds. A final herbicide application of Sharpen and crop oil concentrate was made on June 4. Using the N-STaR results and current recommendations for furrow-irrigated rice, urea plus an approved NBPT product was applied at 180 lb/acre on June 5 and again on June 13 at the same rate. Extension's standard for sufficient nitrogen levels for both midseason and late boot stages was achieved with no additional nitrogen fertilizer. This was unanticipated but was verified weekly with GreenSeeker technology until the onset of head emergence. Irrigation flushes began with the first urea application and, in the absence of rain, were repeated every 3 days, increasing to every 2 days at grain fill. The rice stink bug population was monitored each week after 75% heading until 60% hard dough. The field was checked weekly for diseases. No insecticide or fungicide treatments were required. The rice was harvested on September 14 yielding 214 bu/ac. The milling yield was 45/69. The average harvest moisture was 12.5%. Total irrigation for the season was 27.6 ac-in/ac. Rainfall was 14.84 in.

Crittenden County

The precision-graded Crittenden County field was located 8 miles west of West Memphis and south of Interstate 40 on a Sharky silty clay soil. The field was 50 acres and the previous crop grown was soybean. Conventional tillage practices were used for field preparation in the spring. Based on soil test analysis, no pre-plant fertilizer was applied. The variety Diamond with Apron XL seed treatment was drill-seeded at 84 lb/acre on May 8. A pre-emergence application of Command herbicide was made at planting. Rice emergence was observed on May 21 with a stand count of 16.5 plants/ft². A post-emergence herbicide tank mix of Facet L, Command, Aim, and crop oil concentrate was applied on May 30 providing good weed control. Using the N-STaR recommendation, N fertilizer as urea plus an approved NBPT product was applied pre-flood on June 14 at 175 lb/acre. A permanent flood was subsequently established within 5 days. The MIRI system was utilized for more efficient flood management. On July 5, a midseason N fertilizer application of 100 lb/acre of urea was made based on N level monitoring utilizing GreenSeeker technology. An additional corrective N fertilizer application of 100 lb/acre of urea was made July 12 on a 15-acre area where earlier precision grading required a deeper cut that significantly reduced the soil nitrogen level. The rice stink bug population was monitored each week after 75% heading until 60% hard

dough. The field was checked weekly for diseases. No insecticide or fungicide treatments were required. The rice was harvested on September 23 yielding 174 bu/ac. The milling yield was 63/69. The average harvest moisture was 16.4%. Total irrigation for the season was 18.2 ac-in/ac. Rainfall was 19.17 in.

Desha County

The 75.9-acre contour-levee field was located east of Tiller on Sharkey and Desha clay soil. No tillage practices were performed and the previous crop was rice. According to the soil test a pre-plant fertilizer of 18-46-0 lb/acre (N-P₂O₅-K₂O) was applied in the spring with an airplane. The hybrid RT CLXL745 treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded at 24 lb/acre on May 25. Command, Sharpen, and Glyphosate were applied on April 28 as pre-emergence and burndown herbicides. Emergence was observed on June 10 with 3.7 plants/ft². Regiment and RiceStar herbicides were applied post-emergence on June 29. Nitrogen fertilizer as urea plus an approved NBPT was applied at 300 lb/acre on July 2 according to the N-STaR recommendation. MIRI was utilized to achieve a more efficient permanent flood. Based on GreenSeeker response index during midseason growth stages, midseason N levels were sufficient. Late-boot N was applied as urea at 70 lb/acre on July 29. The field was checked weekly for diseases and due to a history of smut a fungicide application was applied August 1. Stink bugs reached threshold levels and lambda-cyhalothrin insecticide was applied on August 21. The field was harvested on October 3 yielding 164 bu/ac with a milling yield of 64/73. The average harvest moisture was 15%. The irrigation amount was 28 ac-in/ac and the total rainfall was 26.5 in.

Jackson County

The precision-graded Jackson County field was 2 miles west of Newport on Amagon, Forestdale, and Dexter silt loam soils. The field was 20 acres and the previous crop grown on the field was rice. Conventional tillage practices were used for field preparation in the spring after 1 ton of chicken litter was applied. Based on a subsequent soil test analysis, additional mixed fertilizer was also applied on June 6 at 0-40-60 lb/acre (N-P₂O₅-K₂O). The variety Diamond with CruiserMaxx Rice seed treatment was drill-seeded at 70 lb/acre on April 24. A pre-emergence application of Command herbicide was made at planting. Rice emergence was observed on May 8 with a stand count of 15 plants/ft². A post-emergence tank mix application of Prize (quinclorac) plus Prowl H₂O was made on May 23 followed by Propanil plus Permit Plus on May 30. Good weed control was achieved. Using the N-STaR recommendation, N fertilizer as urea plus an approved NBPT product was applied pre-flood on June 6 at 165 lb/acre. A permanent flood was subsequently established within 2 days. MIRI was utilized for a more efficient flood management. On June 22 a Ricestar application was made with a Mud Master self-propelled sprayer on 1.2 acres to control a small area of grass escapes. A midseason N fertilizer application of 100 lb/acre of urea was made on June 27 based on N level monitoring utilizing GreenSeeker technology. The field was checked weekly for diseases. On July 18 a fungicide tank mix of Tilt and Quadris was applied as a control of existing sheath blight and to help prevent false smut. The rice stink bug population was monitored each week after 75% heading until 60% hard dough. Rice stink bugs reached treatment

threshold and an application of lambda-cyhalothrin was made on August 2. The rice was harvested on September 10 yielding 166 bu/ac. The milling yield was 58/73. The average harvest moisture was 15%. Total irrigation for the season was 29.5 ac-in/ac. Rainfall was 16.29 in.

Jefferson County

The 30.4 acre conventional-levee field was located just north of Cornerstone and south of Altheimer. The soil classification consisted of Portland Clay and Herbert silt loam soil. The previous crop grown was soybean. The variety Diamond treated with CruiserMaxx Rice and zinc seed treatments was drill-seeded at 80 lb/acre on April 4. No pre-plant fertilizer was necessary according to soil test results. The herbicides Glyphosate, Command, and First Rate were applied at planting. Emergence was observed on May 26 at 22 plants/ft². SuperWham and RiceOne herbicides were applied April 30. Nitrogen fertilizer in the form of urea was applied at 225 lb/acre with an approved NBPT according to N-STaR recommendations. MIRI was utilized to achieve a more efficient permanent flood. Based on GreenSeeker response index during midseason growth stages, the response index was less than 1.15 and no midseason N fertilizer was recommended. The field was checked weekly for diseases and no fungicide application was required based on field evaluations. Rice stink bugs reached threshold levels and were treated with lambda-cyhalothrin on July 8. The field was harvested on August 19 yielding 180 bu/ac with a milling yield of 57/71. The average harvest moisture was 18%. Total irrigation was 8.2 ac-in/ac and total rainfall was 24.45 in.

Lawrence County

The precision-graded Lawrence County field was located southeast of Hoxie on Jackport silty clay soil. The field was 18 acres and the previous crop grown was rice. Spring conventional tillage practices were used for field preparation and a pre-plant fertilizer based on soil test analysis was applied April 10 at 0-60-0 lb/acre (N-P₂O₅-K₂O). On April 11, the hybrid RT XP753 with the company's standard seed treatment including NipsIt INSIDE insecticide was drill-seeded at 32 lb/acre. Rice emergence was observed on April 30 and consisted of 8.7 plants/ft². A pre-emergence application of Command herbicide was made at planting on April 11 and was followed by a post-emergence application on May 14 of Command plus Regiment and Phase II surfactant. Good weed control was achieved. Using the N-STaR recommendation, N fertilizer as urea plus an approved NBPT product was applied pre-flood at 300 lb/acre on May 28. The permanent flood was established within 4 days. Flood levels were maintained sufficiently throughout the season. GreenSeeker technology was utilized weekly during midseason growth stages to monitor N levels. Streaking of the N application became apparent and a corrective N application of 100 lb/acre of urea was made on June 18. This was followed by a late boot N fertilizer application of urea at 65 lb/acre on July 12. The field was checked weekly for diseases. Based on field evaluations, no fungicide application was required. The rice stink bug population was monitored each week after 75% heading until 60% hard dough. Lambda-cyhalothrin was applied on July 28. The field was harvested on September 10 yielding 210 bu/ac. Moisture at harvest was 17%. The milling yield was 61/71. Total irrigation was 30 ac-in/ac and total rainfall for the season was 14.23 in.

Lee County

The 106.5-acre field was located just west of Moro with the soil classification being Henry silt loam soil. Soybean was the previous crop grown on the field. Conventional tillage practices were performed on the contour-levee field. A pre-plant fertilizer blend of 0-30-90-10 lb/acre (N-P₂O₅-K₂O-Zn) was applied according to the soil sample analysis. The variety Diamond treated with CruiserMaxx Rice plus zinc seed treatment was broadcast at 80 lb/acre on April 29. Command and Sharpen were applied on April 30 as burndown and pre-emergence herbicides. Emergence was observed on May 10 with 15 plants/ft². Facet L and Permit Plus were applied on May 2 as post-emergence herbicides. Based on N-STaR recommendations, N fertilizer as urea plus an approved NBPT product was applied at 260 lb/acre on June 5. A minimal flood was maintained throughout the growing season with MIRI. Based on GreenSeeker response index during midseason growth stages, the response index exceeded 1.15 and midseason N fertilizer was applied as urea at 100 lb/acre on July 2. The field was checked weekly for diseases and no fungicide application was required based on field evaluations. The field was harvested on September 25 with a yield of 181 bu/ac and a milling yield of 57/71. The average harvest moisture was 12%. Total irrigation was 32 ac-in/ac and total rainfall was 13.38 inches.

Lincoln County

The 38-acre zero-grade field was located just north of Star City on a Perry clay soil. The previous crop was soybean. Conventional spring tillage practices were performed on the field. The hybrid RT Gemini 214 CL treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded on June 4. The seeding rate was 25 lb/acre. Glyphosate, Command, and League herbicides were applied at planting. The rice emerged on June 9 at 7.1 plants/ft². On June 21 RiceBeaux and Facet L were applied as post-emergence herbicides. Using the N-STaR recommendation, N fertilizer as urea with an approved NBPT was applied at 275 lb/acre on June 6. According to the soil test a pre-plant fertilizer of 18-46-0 lb/acre (N-P₂O₅-K₂O) was applied with the pre-flood N. Based on GreenSeeker response index during midseason growth stages N levels were adequate. The late boot N fertilizer application was made on July 10 as urea at 75 lb/acre. The field was checked weekly for diseases and no fungicide application was required based on field evaluations. The field was harvested very late on November 20 yielding 171 bu/ac with a milling yield of 54/69. The average harvest moisture was 15.3%. Total irrigation water use was 32 ac-in/ac and total rainfall was 10.6 in.

Lonoke County

The 71.7-acre contour field was located north of Lonoke on a Callaway silt loam soil. Spring conventional tillage practices were used and pre-plant fertilizer was applied at 0-40-60 lb/acre (N-P₂O₅-K₂O) according to the soil test. The hybrid RT XP753 treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded at 20 lb/acre on April 28. Roundup and Command were applied on April 28 as burndown

and pre-emergence herbicides. Stand emergence was observed on May 10 with 4.3 plants/ft². Facet L, Prowl, and RiceBeaux were applied as post-emergence herbicides on May 21. Nitrogen fertilizer in the form of urea with NBPT was applied June 2 according to the N-STaR recommendation. MIRI was utilized to achieve a more efficient permanent flood. Based on GreenSeeker response index during midseason growth stages N levels were adequate. The late-boot N fertilizer application was made on July 13 at 70 lb/acre. The field was harvested on September 30 yielding 195 bu/ac and a milling yield of 55/70. Total irrigation water use was 9.35 ac-in/ac and total rainfall was 21.5 inches.

Monroe County

The 82.8-acre contour field was located southeast of Garrett Grove. The soil classification was Dundee and Foley Calhoun Bonn. Spring conventional tillage practices were used for field preparation and based on soil analysis a 0-0-60-10 lb/acre (N-P₂O₅-K₂O-Zn) was applied. Top Choice fertilizer was applied in the spring at 500 lb/acre. The hybrid RT XP753 treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded at 22 lb/acre on April 28. Command herbicide was applied at planting. Emergence was observed on May 11 with 7.3 plants/ft². SuperWham, Prowl, and Permit were applied as post-emergence herbicides on May 12. Regiment and Facet L herbicides were applied May 28. Using the N-STaR recommendation, N fertilizer as urea was applied at 250 lb/acre on June 4. Based on GreenSeeker response index during midseason growth stages, N levels were adequate. Late-boot N fertilizer was applied as urea at 70 lb/acre on July 2. Stink bugs also reached threshold levels and lambda-cyhalothrin was applied on August 6. The field was harvested September 14 yielding 175 bu/ac. The milling yield was 60/74 and the average harvest moisture was 17%. Total irrigation for the season was 34 ac-in/ac and total rainfall was 19.25 inches.

Randolph County

The precision-graded Randolph County field was located 6 miles northeast of Pocahontas near the Fourche River on a Hontas silt loam soil. This was the 4th rice crop following precision-grading work. The field was 42 acres and the previous crop grown on the field was rice. An application of chicken litter at 2 tons/ac was made in the spring and conventional tillage practices were used for field preparation. A mixed fertilizer based on soil test analysis was applied at 0-0-60-5 lb/acre (N-P₂O₅-K₂O-Zn). The hybrid RT CLXP4534 treated with the company's standard seed treatment including NipsIt INSIDE was drill-seeded at 22 lb/acre on April 9. Rice emergence was observed on May 6. The stand count was not as uniform as desired but keeping the stand was determined to be the best option. Command was applied as a pre-emergence herbicide on April 10 followed by a post-emergence application of Clearpath and crop oil concentrate on May 14 providing good weed control. Based on N-STaR recommendations, a pre-flood application of urea plus an approved NBPT product was made on June 2 at 165 lb/acre. Surface water was utilized to achieve a permanent flood. Extension's standard for sufficient midseason N levels was achieved with the pre-flood N rate and verified with GreenSeeker technology. A late boot N fertilizer application of urea was made at 65 lb/acre on July 10. The rice stink bug population exceeded treatment threshold and Mustang Maxx was applied on July 18. The field was checked weekly for diseases and

no fungicide treatments were required. The rice was harvested on September 3 yielding 181 bu/ac. The milling yield was 63/71. The average harvest moisture was 16.3%. Total irrigation for the season was 16.8 ac-in/ac. Rainfall was 18.23 inches.

White County

The precision-graded White County field was located south of Kensett on Calhoun and Callaway silt loam soils. The field was 74 acres and the previous crop grown was soybean. Spring conventional tillage practices were used for field preparation and a pre-plant fertilizer based on soil test analysis was applied at 0-47-127-3 lb/acre (N-P₂O₅-K₂O-Zn). A burndown herbicide application of glyphosate was made on May 18. On May 20, the hybrid RT XP753 with the company's standard seed treatment including NipsIt INSIDE insecticide was drill-seeded on 50 acres at 24 lb/acre before planting was halted by rain. Planting resumed on May 25 with the same cultivar and rate on the remaining 24 acres. Rice emergence on the initial 50 acres was observed on May 27 and on the remaining 24 acres on June 3. The stand count consisted of 7.6 plants/ft² and 6.1 plants/ft², respectively. An application of RiceOne (clomazone + pendimethalin premix) plus Prowl H₂O herbicides was made on May 28 followed by a post-emergence application of RiceBeaux on June 21 providing good control of weeds. Using the N-STaR recommendation, N fertilizer as urea plus an approved NBPT product was applied pre-flood at 240 lb/acre on June 21. A permanent flood of reservoir water was established within 4 days. Flood levels were maintained sufficiently throughout the season. GreenSeeker technology was utilized weekly during midseason growth stages and no midseason N was recommended. A late boot N fertilizer application of urea was made at 65 lb/acre on August 2. Based on evaluating the field weekly for diseases, no fungicide application was required. The rice stink bug population was monitored each week after 75% heading until 60% hard dough. Rice stink bugs reached the threshold for treatment prompting an application of Lambda-Cy on August 12. The field was harvested on September 27 yielding 175 bu/ac. Moisture at harvest was 16.5%. Total irrigation was 30 ac-in/ac and total rainfall for the season was 15.5 inches.

Woodruff County

The precision-graded Woodruff County field was located 3 miles south of McCrory on Wiville fine sandy loam and Tuckerman loam soils. The field was 36 acres and the previous crop grown was soybean. Spring conventional tillage practices were used for field preparation and a pre-plant fertilizer based on soil test analysis was applied at 0-60-90-2 lb/acre (N-P₂O₅-K₂O-Zn). On April 24, the variety Diamond with CruiserMaxx Rice seed treatment was drill-seeded at 70 lb/acre on 12 acres before a breakdown occurred with the grain drill. The remaining 24 acres was broadcast that day with the same cultivar and seed treatment at 112.5 lb/acre and covered with a harrow. Rice emergence was observed on May 2 and consisted of 26.6 plants/ft² drilled and 27 plants/ft² broadcast. A pre-emergence application of Command herbicide was made on April 24 followed by a post-emergence tank mix herbicide application of Super Wham, Permit, Facet L, and crop oil concentrate on May 30. On May 31 the N-STaR recommendation of 240 lb/acre of urea plus an approved NBPT product was applied. Flood-up occurred over the next 7 days using the MIRI system. GreenSeeker technology was utilized during midseason

growth stages to monitor the crop's N level. The planned midseason N application was made with urea at 100 lb/acre on June 27. The field was checked weekly for diseases. On July 20, Quilt Xcel was applied for sheath blight and false smut control. The rice stink bug population was monitored each week after 75% heading until 60% hard dough. No insecticide treatments were made. The field was harvested on September 14. The yield was 194 bu/ac. Moisture at harvest was 15%. The milling yield was 57/71. Total irrigation was 68.7 ac-in/ac and total rainfall for the season was 9.95 inches.

Table 1. Agronomic information for fields enrolled in the 2019 Rice Research Verification Program.

Field Location by County	Cultivar	Field size (acres)	Previous crop	Seeding rate (lbs/acre)	Stand density (plants/ft ²)	Planting date	Emergence date	Harvest date	Yield (bu/A)	Milling yield ^f	Harvest Moisture
Arkansas	Diamond	60	Soybean	65	14	28-Apr	13-May	27-Oct	184	52/69	16%
Chicot	RT Gemini 214 CL	57	Soybean	23	6	3-Apr	29-May	12-Aug	187	53/58	20%
Craighead	RT XP753	68	Soybean	25	6	30-Apr	15-May	14-Sep	214	45/69	13%
Crittenden	Diamond	50	Soybean	84	17	8-May	21-May	23-Sep	174	63/69	16%
Desha	CL XL 745	76	Rice	24	4	25-May	10-June	3-Oct	164	64/73	15%
Jackson	Diamond	20	Rice	70	15	24-Apr	5-May	10-Sep	166	58/73	15%
Jefferson	Diamond	30	Soybean	80	22	3-Apr	26-Apr	19-Aug	180	57/71	18%
Lawrence	RT XP753	18	Rice	32	9	11-Apr	30-Apr	10-Sep	210	61/71	17%
Lee	Diamond	107	Soybean	80	15	29-May	10-May	25-Sep	181	57/71	12%
Lincoln	RT Gemini 214 CL	38	Soybean	25	7	4-June	9-June	11-Nov	171	54/69	15%
Lonoke	RT XP753	72	Soybean	20	4	28-May	10-May	30-Sep	195	55/70	14%
Monroe	RT XL753	83	Corn	22	7	28-Apr	11-May	14-Sep	175	60/74	17%
Randolph	RT CL XP4534	42	Rice	22	5	9-Apr	6-June	3-Sep	181	63/71	16%
White ^b	RT XP753	50	Soybean	24	7.6	20-May	27-May	27-Sep	175	55/71	17%
White ^c	RT XP753	24	Soybean	24	5	25-May	3- June	27-Sep	175	55/71	17%
Woodruff ^d	Diamond	12	Soybean	70	27	24-Apr	2-May	14-Sep	194	57/71	15%
Woodruff ^e	Diamond	24	Soybean	113	27	24-Apr	2-May	14-Sep	194	57/71	15%
Average	-----	55	-----	f	g	4-May	16-May	20-Sep	183	57/70	16.%

^a Milling yield numbers : First number = % Head rice (whole white grains) / Second number = % Total white rice (whole grains + broken grains).

^b Represents 50 of 74 acres planted in the White County field before rain halted planting.

^c Represents remaining 24 of 74 acres planted in the White County field after conditions allowed planting to resume.

^d Represents 12 of 36 acres in the Woodruff County field drill seeded before mechanical failure of grain drill.

^e Represents remaining 24 of 36 acres in the Woodruff County field broadcast seeded after mechanical failure of grain drill.

^f Seeding rates averaged 80 lbs/acre for conventional cultivars and 24 lbs/acre for hybrid cultivars.

^g Stand density averaged 18 plants/ft² for conventional cultivars and 6 plants/ft² for hybrid cultivars.

Table 2. Soil test results, fertilization program, and soil classification for fields enrolled in the 2019 Rice Research Verification Program.

Field Location by County	Soil Test				Applied Fertilizer (lbs/acre)			Soil Classification
	pH	lbs/acre			Mixed Fertilizer ^a N-P-K-Zn ^b	N-Star Urea (46%N) rates and timing ^{c, d}	Total N rate ^e (lbs N/acre)	
		P	K	Zn				
Arkansas	7.0	64	230	10	0-50-60-10	170-100-0	124	Dewitt silt loam
Chicot	7.0	45	594	3.2	18-46-0-0	390-0-70	212	Perry clay
Craighead	6.3	58	146	1.5	0-42-120-0	180-180-0*	166	Mhoon & Dundee sandy loam
Crittenden	6.4	74	948	7.6	0-0-0-0	175-100-0	173+	Sharkey silty clay
Desha	6.8	19	756	5.9	18-46-0-0	300-0-70	170	Sharkey and Desha clay
Jackson	6.2	31	201	8.2	0-40-60-0	165-100-0	122	Amagon & Forestdale silt loam
Jefferson	6.9	56	684	6.0	0-0-0-0	225-0-0	103	Portland clay/Herbert silt lm.
Lawrence	7.1	20	326	6.6	0-60-0-0	300-0-65	215+	Jackport silty clay
Lee	7.4	66	182	3.9	0-30-90-10	260-100-50	166	Perry clay
Lincoln	6.6	40	498	4.4	0-60-90-10	240-0-70	195	Callaway silt loam
Lonoke	5.7	24	212	0.8	0-60-90-10	240-70-0	143	Henry silt loam
Monroe	7.0	70	198	5.1	0-0-60-10	250-70-0	147	Foley Calhoun Bonn Dundee silt
Randolph	7.0	80	219	7.1	0-0-60-5	164-0-65	105	Hontas silt loam
White	6.6	75	122	2.9	0-47-127-5	240-0-65	140	Calhoun/Calloway silt loam
Woodruff	6.6	30	220	6.2	0-60-90-2	240-100-0	156	Wiville fine sandy loam

^a Column represents regular pre-plant applications .

^b N=nitrogen, P=phosphorus, K=potassium, Zn=zinc.

^c Timing: pre-flood – midseason – boot. Each field was fertilized according to its N-STaR recommendation. The mark (*) denotes an adjusted N-STaR rate and timing for furrow irrigated rice.

^d The N-Star pre-flood N recommendation in all fields was treated with an approved NBPT product to minimize N loss due to ammonia volatilization.

^e Certain fields received additional seasonal N exceeding the N-Star recommendation by 46 lbs due to factors encountered during the season post-flood. This additional N is included in the totals marked (+). Extra N applied 2 weeks or more before flood-up to address other issues is recorded in the Mixed Fertilizer column.

Table 3. Herbicide rates and timings for fields enrolled in the 2019 Rice Research Verification Program.

Field Location by County	Burndown/Pre-emergence Herbicide Applications (Trade name & product rate/acre)^x	Post-emergence Herbicide Applications (Trade name & product rate/acre)^x
Arkansas	Glyphosate (1 qt) + Command (12.8 oz) + League (6.4 oz)	Facet L (32 oz) + COC (16 oz)
Chicot	Newpath (4 oz) + Command (12.8 oz) + League (6.4 oz)	Clearpath (0.5 lb) + COC (32 oz)
Craighead	RoundUp Maxx (1 qt) + 2,4-D (24 oz) + First Shot (0.6 oz) FB Command (12.8 oz) + Facet L (22 oz)	Prowl H ₂ O (33.6 oz) + Command (sequential 10 oz) FB Sharpen (1 oz) + COC (20 oz)
Crittenden	Command (24 oz)	Facet L (32 oz) + Aim (1 oz) + Command (sequential 8 oz) + (COC 6.4 oz)
Desha	Command (21 oz) + Sharpen (2 oz) + Glyphosate (32 oz)	Regiment (0.63 oz) + RiceStar (24 oz) + COC (32 oz)
Jackson	Command (12.8 oz)	Prize (12 oz) + Prowl H ₂ O (2 pts) FB Propanil (3 qts) + Permit Plus (0.75 oz) FB Ricestar (24 oz) as spot treatment (1.2 acres)
Jefferson	Glyphosate (32 oz) + Command (16 oz) + First Shot (0.5 oz)	SuperWham (3 qts) + Rice One (45 oz) + COC (1 pt)
Lawrence	Command (16 oz)	Command (sequential 6 oz) + Regiment (0.67 oz) + Phase II Surfactant (6.4 oz)
Lee	Command (12.8 oz) + Sharpen (2 oz)	Facet L (32 oz) + Permit Plus (0.75 oz)
Lincoln	Glyphosate (32 oz) + Command (20 oz) + League (6.4 oz)	RiceBeaux (32 oz) + Facet L (32 oz)
Lonoke	Glyphosate (32 oz) fb Roundup (36 oz) + Command (12.8 oz)	Facet L (32 oz) + (Prowl (32 oz) + RiceBeaux (3 qts)
Monroe	Command (12.8 oz) fb SuperWham (4 qts) + Permit (1 oz) + Prowl (2.1 pt)	Regiment (0.63 oz) + Facet L (43 oz) + COC (32 oz)
Randolph	Command (12.8 oz)	Clearpath (0.5 lb) + COC (6.4 oz)
White	Glyphosate (48 oz) FB RiceOne (24 oz) + Prowl H ₂ O (0.9 pt)	RiceBeaux (3 qt)
Woodruff	Glyphosate (32 oz) FB Command (16 oz)	Super Wham (3.5 qts) + Permit (1 oz) + Facet L (32 oz) + COC (1 pt)

^x 'FB' = 'followed by' and is used to separate herbicide application events; COC = Crop Oil Concentrate

Table 4. Seed treatments used and foliar fungicide and insecticide applications made on fields enrolled in the 2019 Rice Research Verification Program.

Field Location by County	Seed treatments (trade name and product rate/cwt seed)	Foliar fungicide and insecticide applications (trade name and product rate/acre)			
	Fungicide and/or Insecticide Seed Treatment for Control of Diseases and Insects of Seedling Rice ^z	Fungicide Applications for Control of Sheath Blight/Kernel Smut/False Smut	Fungicide Applications for Control of Rice Blast	Insecticide Applications for Control of Rice Water Weevil	Insecticide Applications for Control of Rice Stink Bug/Chinch Bug
Arkansas	CruiserMaxx Rice (7 fl oz)	-----	-----	-----	Lambda-Cyhalothrin (2.5 oz)
Chicot	RTST	-----	-----	-----	Lambda-Cyhalothrin (1.6 oz)
Craighead	RTST	-----	-----	-----	-----
Crittenden	Apron XL	-----	-----	-----	-----
Desha	RTST	-----	-----	-----	-----
Jackson	CruiserMaxx Rice (7 fl oz)	Tilt (5 oz) + Quadris (8 oz)	-----	-----	Lambda-Cyhalothrin (2 oz)
Jefferson	CruiserMaxx Rice (7 fl oz) Zinc	-----	-----	-----	Lambda-Cyhalothrin (1.8 oz)
Lawrence	RTST	-----	-----	-----	Lambda-Cyhalothrin (3.6 oz)
Lee	CruiserMaxx Rice (7 fl oz)	-----	-----	-----	-----
Lincoln	RTST	-----	-----	-----	-----
Lonoke	RTST	-----	-----	-----	-----
Monroe	RTST	-----	-----	-----	Lambda-Cyhalothrin (2.1 oz)
Randolph	RTST	-----	-----	-----	Mustang Maxx (4 oz)
White	RTST	-----	-----	-----	Lambda-Cyhalothrin (3.7 oz)
Woodruff	CruiserMaxx Rice (7 fl oz) Zinc	Quilt Xcel (21 oz)	-----	-----	-----

^z RTST = 'RiceTec Seed Treatment'. This abbreviation defines those fields with seed treated by RiceTec, Inc. prior to seed purchase. 'RTST seed is treated with zinc and compounds intended to enhance germination and early-season plant growth, plus the insecticide NipsIt INSIDE to further protect seedlings.

Table 5. Rainfall and irrigation information for fields enrolled in the 2019 Rice Research Verification Program.

Field Location by County	Rainfall (inches)	Irrigation^z (acre inches)	Rainfall + Irrigation (inches)
Arkansas	33.0	21.5	54.5
Chicot	26.5	36.0	62.5
Craighead	14.8	27.6	42.4
Crittenden	19.2	18.2	37.4
Desha	26.1	30.0*	56.1
Jackson	16.3	29.5	45.8
Jefferson	24.5	8.2	32.7
Lawrence	14.2	30.0*	44.2
Lee	13.4	30.0*	43.4
Lincoln	10.6	34.5	45.1
Lonoke	21.5	9.4	30.9
Monroe	19.3	30.0*	49.3
Randolph	18.2	16.8	35.0
White	15.5	30.0*	45.5
Woodruff	9.9	68.7	78.7
Average	18.9	27.0	46.5

^z Not all fields were equipped with flow meters to monitor water use for irrigation. Therefore, the average irrigation amount in fields with flow meters over a period of years was calculated and this average was used for fields with no irrigation data. Irrigation amounts using this calculated average are followed by an asterisk (*).

ECONOMIC ANALYSIS

This section provides information on production costs and returns for the 2019 Rice Research Verification Program (RRVP). Records of field operations on each field provided the basis for estimating production costs. The field records were compiled by the RRVP coordinators, county Extension agents, and cooperators. Production data from the 16 fields were applied to determine costs and returns above operating costs, as well as total specified costs. Operating costs and total costs per bushel indicate the commodity price needed to meet each cost type.

Operating costs are those expenditures that would generally require annual cash outlays and would be included on an annual operating loan application. Actual quantities of all operating inputs as reported by the cooperators are used in this analysis. Input prices are determined by data from the 2019 Crop Enterprise Budgets published by the Cooperative Extension Service and information provided by the cooperating producers. Fuel and repair costs for machinery are calculated using a budget calculator based on parameters and standards established by the American Society of Agricultural and Biological Engineers. Machinery repair costs should be regarded as estimated values for full-service repairs, and actual cash outlays could differ as producers provide unpaid labor for equipment maintenance.

Fixed costs of machinery are determined by a capital recovery method which determines the amount of money that should be set aside each year to replace the value of equipment used in production. Machinery costs are estimated by applying engineering formulas to representative prices of new equipment. This measure differs from typical depreciation methods, as well as actual annual cash expenses for machinery.

Operating costs, fixed costs, costs per bushel, and returns above operating and total specified costs are presented in Table 6. Costs in this report do not include land costs, management, or other expenses and fees not associated with production. Operating costs ranged from \$388.32/acre for Jefferson County to \$767.80 for Woodruff County, while operating costs per bushel ranged from \$2.16/bu for Jefferson County to \$4.11/bu for Monroe County. Total costs per acre (operating plus fixed) ranged from \$471.80/acre for Jefferson County to \$944.48/acre for Woodruff County, and total costs per bushel ranged from \$2.62/bu for Jefferson County to \$5.03/bu for Monroe County. Returns above operating costs ranged from \$209.13/acre for Lincoln County to \$532.19/acre for Jefferson County, and returns above total costs ranged from \$47.63/acre for Woodruff County to \$448.71/acre for Jefferson County.

A summary of yield, rice price, revenues, and expenses by expense type for each RRVP field is presented in Table 7. The average rice yield for the 2019 RRVP was 183 bushels/acre but ranged from 164 bushels/acre for Desha County to 214 bushels/acre for Craighead County. An Arkansas average long-grain cash price of \$5.01/bu was estimated using USDA, National Agricultural Statistics Service (NASS) US long grain price data for the months of August through October. The RRVP had all fields planted to long grain rice. A premium or discount was given to each field based on the milling yield observed for each field and a standard milling yield of 55/70 for long-grain rice. Broken rice was assumed to have 65% of whole grain price value. If milling yield was higher than the standard, a premium was made while a discount was given for milling less than the standard. Estimated long-grain prices adjusted for milling yield varied from \$4.69/bu in Crittenden County to \$5.40/bu in Desha County (Table 7).

The average operating expense for the 15 RRVP fields was \$584.93/acre (Table 7). Fertilizers & nutrients expenses accounted for the largest share of operating expenses on average (19.6%) followed by post-harvest expenses (18.9%), seed (18.7%), and chemicals (12.7%). Although seed's share of operating expenses was 18.7% across the 15 fields, it's average cost and share of operating expenses varied depending on whether a Clearfield hybrid was used (\$162.00/acre; 26.2% of operating expenses), a non-Clearfield hybrid was used (\$147.85/acre; 23.6% of operating expenses), or a non-Clearfield non-

hybrid (pureline) variety was used (\$41.99/acre; 7.9% of operating expenses). None of the 15 RRVP fields in 2019 planted a Clearfield non-hybrid (pureline) variety.

The average return above operating expenses for the 15 fields was \$353.68/acre and ranged from \$209.13/acre for Lincoln County to \$532.19/acre for Jefferson County. The average return above total specified expenses for the 15 fields was \$236.18/acre and ranged from \$47.63/acre for Woodruff County to \$448.71/acre for Jefferson County. Table 8 provides select variable input costs for each field and includes a further breakdown of chemical costs into herbicides, insecticides, and fungicides. Table 8 also lists the specific rice cultivars grown on each RRVP field.

Table 6. Operating Costs, Total Costs, and Returns for fields enrolled in the 2019 Rice Research Verification Program.

County	Operating Costs (\$/acre)	Operating Costs (\$/bushel)	Returns to Operating Costs (\$/acre)	Fixed Costs (\$/acre)	Total Costs (\$/acre)	Returns to Total Costs (\$/acre)	Total Costs (\$/bushel)
Arkansas	451.74	2.46	446.06	92.12	543.86	353.95	2.96
Chicot	638.43	3.41	360.73	89.30	727.73	271.43	3.89
Craighead	652.56	3.05	351.67	95.06	747.63	256.60	3.49
Crittenden	440.08	2.53	459.98	101.74	541.81	358.25	3.11
Desha	607.35	3.70	278.56	123.36	730.71	155.20	4.46
Jackson	641.89	3.87	228.25	119.20	761.09	109.06	4.58
Jefferson	388.32	2.16	532.19	83.48	471.80	448.71	2.62
Lawrence	693.69	3.30	402.64	125.59	819.28	277.05	3.90
Lee	483.65	2.67	441.98	113.42	597.07	328.55	3.30
Lincoln	634.36	3.71	209.13	143.41	777.77	65.72	4.55
Lonoke	502.48	2.58	474.47	76.59	579.07	397.88	2.97
Monroe	719.34	4.11	216.18	160.23	879.57	55.95	5.03
Randolph	590.44	3.26	364.15	123.92	714.36	240.24	3.95
White	561.85	3.21	314.90	138.39	700.24	176.51	4.00
Woodruff	767.80	3.96	224.31	176.68	944.48	47.63	4.87
Average	584.93	3.20	353.68	117.50	702.43	236.18	3.85

Table 7. Summary of Revenue and Expenses per Acre for fields enrolled in the 2019 Rice Research Verification Program.

Receipts	Arkansas	Chicot	Craighead	Crittenden	Desha	Jackson	Jefferson	Lawrence
Yield (bu.)	184	187	214	174	164	166	180	210
Price Received	4.88	5.34	4.69	5.17	5.40	5.24	5.11	5.22
Total Crop Revenue	897.80	999.16	1004.23	900.06	885.91	870.15	920.51	1096.34
Operating Expenses								
Seed	36.40	167.90	150.25	29.99	149.76	39.20	48.64	192.32
Fertilizers & Nutrients	97.02	135.88	120.99	87.69	121.43	125.78	59.51	119.03
Chemicals	73.59	68.30	68.42	50.24	79.14	127.90	76.29	26.21
Custom Applications	37.60	55.20	52.30	45.50	74.40	84.20	34.00	71.00
Diesel Fuel	13.30	11.11	10.22	16.38	14.13	17.16	14.14	17.92
Repairs & Maintenance	20.44	19.02	19.78	22.21	27.53	26.43	18.97	27.36
Irrigation Energy Costs	43.47	47.42	81.50	53.74	18.67	87.11	10.80	88.58
Labor, Field Activities	9.06	6.67	5.95	9.16	9.02	8.24	9.16	8.67
Other Inputs & Fees, Pre-harvest	9.82	14.07	14.01	20.17	14.31	25.70	8.19	15.87
Post-harvest Expenses	111.04	112.85	129.15	105.01	98.97	100.18	108.63	126.74
Total Operating Expenses	451.74	638.43	652.56	440.08	607.35	641.89	388.32	693.69
Returns to Operating Expenses	446.06	360.73	351.67	459.98	278.56	228.25	532.19	402.64
Capital Recovery & Fixed Costs	92.12	89.30	95.06	101.74	123.36	119.20	83.48	125.59
Total Specified Expenses ²	543.86	727.73	747.63	541.81	730.71	761.09	471.80	819.28
Returns to Specified Expenses	353.95	271.43	256.60	358.25	155.20	109.06	448.71	277.05
Operating Expenses/Yield Unit	2.46	3.41	3.05	2.53	3.70	3.87	2.16	3.30
Total Expenses/Yield Unit	2.96	3.89	3.49	3.11	4.46	4.58	2.62	3.90

² Does not include land costs, management, or other expenses and fees not associated with production.

Table 7. Summary of Revenue and Expenses per Acre for fields enrolled in the 2019 Rice Research Verification Program (Continued).

Receipts	Lee	Lincoln	Lonoke	Monroe	Randolph	White	Woodruff	Average
Yield (bu.)	181	171	195	175	181	175	194	183
Price Received	5.11	4.93	5.01	5.35	5.27	5.01 ^z	5.11	5.12
Total Crop Revenue	925.63	843.49	976.95	935.52	954.59	876.75	992.11	938.61
Operating Expenses								
Seed	44.80	182.50	120.20	132.22	147.84	144.24	52.93	109.28
Fertilizers & Nutrients	116.44	128.33	95.44	131.78	156.08	110.69	109.43	114.37
Chemicals	69.16	71.20	73.50	125.20	42.56	47.55	113.73	74.20
Custom Applications	36.80	58.00	35.20	44.00	52.62	65.70	74.20	54.71
Diesel Fuel	19.56	23.88	13.35	24.97	19.28	17.84	20.95	16.95
Repairs & Maintenance	23.41	29.92	16.84	30.45	27.96	30.94	36.24	25.17
Irrigation Energy Costs	42.15	8.85	12.32	94.49	9.80	17.50	202.86	54.62
Labor, Field Activities	11.37	13.56	6.96	13.49	11.49	8.86	11.78	9.56
Other Inputs & Fees, Pre-harvest	10.72	14.92	11.00	17.13	13.58	12.91	28.62	15.40
Post-harvest Expenses	109.23	103.20	117.68	105.61	109.23	105.61	117.08	110.68
Total Operating Expenses	483.65	634.36	502.48	719.34	590.44	561.85	767.80	584.93
Returns to Operating Expenses	441.98	209.13	474.47	216.18	364.15	314.90	224.31	353.68
Capital Recovery & Fixed Costs	113.42	143.41	76.59	160.23	123.92	138.39	176.68	117.50
Total Specified Expenses ^y	597.07	777.77	579.07	879.57	714.36	700.24	944.48	702.43
Returns to Specified Expenses	328.55	65.72	397.88	55.95	240.24	176.51	47.63	236.18
Operating Expenses/Yield Unit	2.67	3.71	2.58	4.11	3.26	3.21	3.96	3.20
Total Expenses/Yield Unit	3.30	4.55	2.97	5.03	3.95	4.00	4.87	3.85

^z The White County RRVP field did not have a milling yield sample collected. The average price of \$5.01/bu was used for White County.

^y Does not include land costs, management, or other expenses and fees not associated with production.

Table 8. Selected Variable Input Costs per Acre for fields enrolled in the 2019 Rice Research Verification Program.

County	Rice Type	Seed	Fertilizers & Nutrients	Herbicides	Insecticides	Fungicides and Other Inputs	Diesel Fuel	Irrigation Energy Costs
Arkansas	Diamond	36.40	97.02	68.86	4.73	---	13.30	43.47
Chicot	Gemini 214 CL	167.90	135.88	65.28	3.02	---	11.11	47.42
Craighead	XL753	150.25	120.99	68.42	---	---	10.22	81.50
Crittenden	Diamond	29.99	87.69	50.24	---	---	16.38	53.74
Desha	CLXL745	149.76	121.43	70.67	3.97	4.50	14.13	18.67
Jackson	Diamond	39.20	125.78	105.73	3.78	18.39	17.16	87.11
Jefferson	Diamond	48.64	59.51	72.21	3.40	0.68	14.14	10.80
Lawrence	XL753	192.32	119.03	19.41	6.80	---	17.92	88.58
Lee	Diamond	44.80	116.44	69.16	---	---	19.56	42.15
Lincoln	Gemini 214 CL	182.50	128.33	71.20	---	---	23.88	8.85
Lonoke	XP753	120.20	95.44	73.50	---	---	13.35	12.32
Monroe	XP753	132.22	131.78	121.23	3.97	---	24.97	94.49
Randolph	CLXP4534	147.84	156.08	37.20	5.36	---	19.28	9.80
White	XP753	144.24	110.69	40.63	6.92	---	17.84	17.50
Woodruff	Diamond	52.93	109.43	93.22	---	20.51	20.95	202.86
Average	---	109.28	114.37	68.46	4.66	11.02	16.95	54.62