DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

2020
University of Arkansas
Rice Research Verification Program

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University of Arkansas
Cooperative Extension Service
Agriculture Experiment Station
U.S. Department of Agriculture
And County Governments Cooperating

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RICE RESEARCH VERIFICATION PROGRAM, 2020

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INTRODUCTION

The 2020 growing season was the thirty-seventh 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.

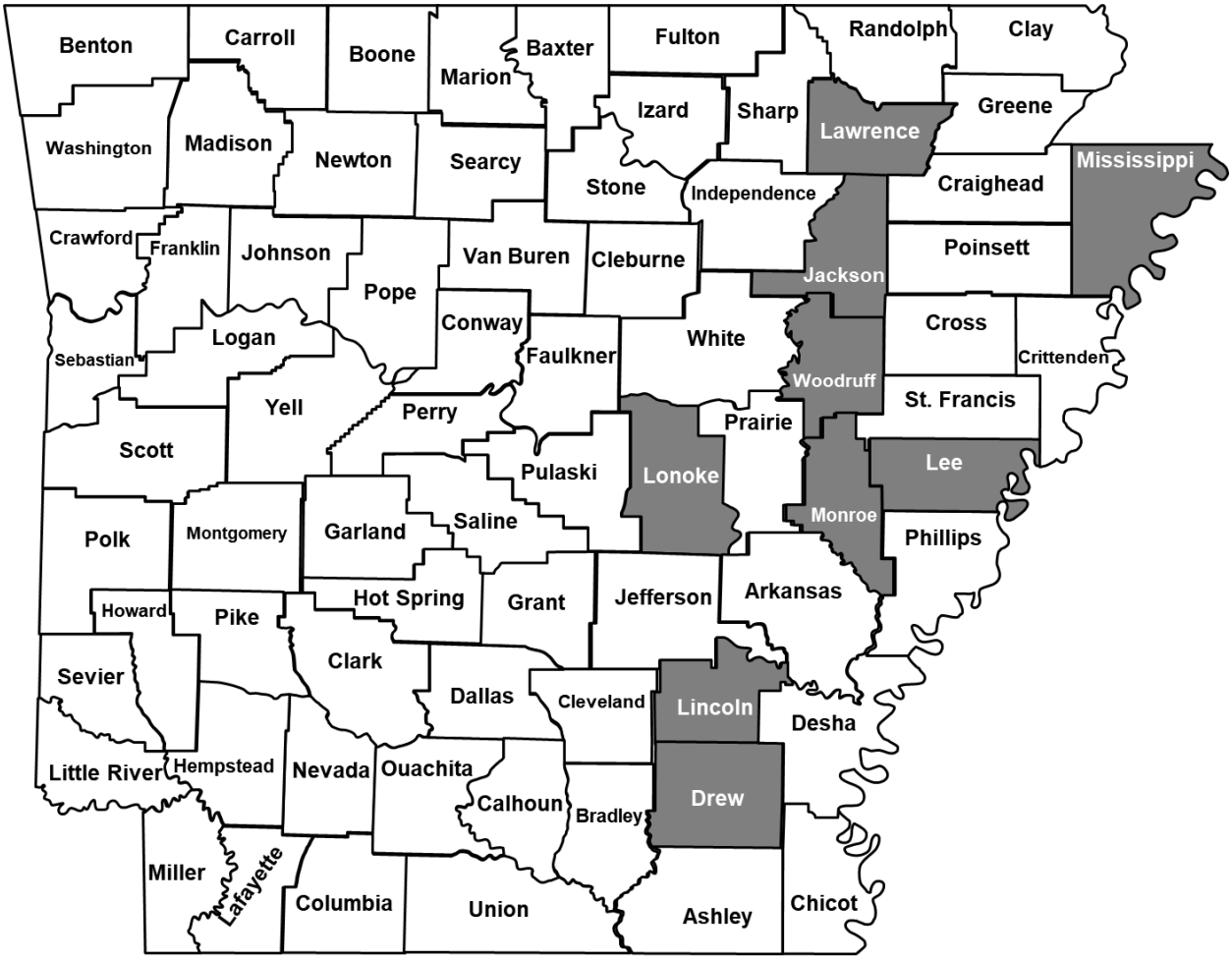
6. To provide training and assistance to county agents and growers with limited expertise in rice production.

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. Nine fields were enrolled in the RRVP in 2020. The fields were located on commercial farms ranging in size from 40 to 145 acres. The average field size was 73 acres.

Counties participating in the program during 2020 included Drew, Jackson, Lawrence, Lee, Lincoln/Jefferson, Lonoke, Mississippi, Monroe, Woodruff. (Figure 1).

The nine rice fields totaled 661 acres enrolled in the program. Six different cultivars were seeded: (Diamond [2 fields]; RiceTec [RT] XP753 [2 fields]; RT 7301 [2 fields]; RT 7321 FP [1 field]; RT 7521 FP [1 field]; and Horizon Ag CLL15 [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 2020 Rice Research Verification Program Fields.



FIELD REVIEWS

Southern Coordinator – Ralph Mazzanti

Drew County

The Drew County furrow-irrigated rice (FIR) field was located just west of Tiller on Perry Clay soil. The field consisted of 40 acres and the previous crop grown was soybean. The cultivar chosen was RT 7521 FP treated with the company's standard seed treatment. The field was drill-seeded at 23 lbs/ac planted May 4. Emergence was observed on May 18 with a stand count of 7.1 plants/ft^2. No tillage practices were used for spring field preparation. According to the soil test a 18-46-0 (lb/acre N-P_2O_5-K_2O) was applied with 50 lbs/acre ammonium sulfate. Glyphosate, Command, and Sharpen herbicides were applied at planting on May 4. Preface, Facet, and Prowl H_2O were applied as post-emergence herbicides on May 22. Command and Preface herbicides were applied on June 4 followed by Regiment and Preface applied June 18. N-STaR (Nitrogen Soil Test for Rice) was utilized on the field. Nitrogen in the form of urea plus an approved NBPT was applied at 165 lbs/acre on June 3 followed by 165 lbs/acre on June 18. Two more applications were made with 100 lbs/acre on June 24 followed by 65 lbs/acre on July 25. Using Trimble GreenSeeker, the N response levels remained adequate throughout the season. Intermittent flushing was utilized for irrigation. Sheath blight disease was prevalent on the upper end of the field yet never reached threshold levels. Rice stink bugs numbers remained low and did not require treatment. The field was harvested on September 12 yielding 184 bu/ac and a milling yield of 63/69. The average harvest moisture was 16%. Total irrigation was 30 ac-in/ac and total rainfall was 17.5 inches.

Jackson County

The precision-graded furrow-irrigated rice (FIR) field was located 2 miles west of Newport on Amagon, Forestdale, and Dexter silt loam soils. The field was 140 acres and the previous crop grown was soybean. A hipper was used prior to drill-seeding on April 17 at a seeding rate of 25 lbs/acre. The cultivar was RT XP753 with the company's standard seed treatment. A pre-emergence application of Command herbicide plus glyphosate for burndown was applied at planting. Rice emergence was observed on May 5 with a stand count of 6.7 plants/ft^2. A post-emergence tank mix application of Prize (quinclorac) plus Prowl H_2O plus Command was made on May 10 followed by Command on May 15. Loyant herbicide was applied on part of the field (40 acres) for pigweed control on June 1 followed by a 2,4-D amine application on June 16. Using the N-STaR recommendation, N fertilizer in the form of urea plus an approved NBPT product was applied preflood on June 8 at 160 lb/acre. The second N application was made June 20 at 160 lbs/acre. The third N application was made on June 26 at 100 lbs/acre. The late-boot N application was made on July 16 at 65 lbs/acre. Intermittent flushing was utilized for water management. The field never reached treatment level for disease or stink bugs. The rice was harvested on September 13 yielding 215 bu/ac. The milling yield was 62/70. The average harvest moisture was 18%. Total irrigation for the season was 30.5 ac-in/ac. Rainfall was 19.05 inches.

Lawrence County

The Lawrence County field was located northwest of Hoxie on Foley-Calhoun complex and McCrory fine sandy loam soil. The field was 35 acres and the previous crop grown was soybean. No spring conventional tillage practices were used for field preparation and a pre-plant fertilizer based on soil test analysis was applied April 20 at 0-50-90 lb/acre (N-P_2O_5-K_2O). Prior to planting Roundup PowerMaxx was applied for burndown. On April 30, CLL15 treated with CruiserMaxx Rice, zinc, and Release was drill-seeded at 80 lbs/acre. Pre-emergence herbicides Command, Bolero, and Prowl H_2O were applied on April 26. Rice emergence was observed on May 5 at 19 plants/ft^2. Newpath herbicide was applied May 30. Regiment herbicide was applied for grass escapes with a MudMaster trimming the field (10 acres). The levees were sprayed with Stam, Facet, Loyant, and Permit herbicides. Using the N-STaR recommendation, urea plus an approved NBPT product was applied preflood at a rate of 260 lbs/acre. The permanent flood was established within 4 days utilizing multiple-inlet rice irrigation (MIRI). Flood levels were adequately maintained throughout the growing season. Trimble GreenSeeker technology was utilized prior to midseason growth stages to monitor N levels. Midseason N in the form of urea was applied July 2 at 100 lbs/acre. Propiconazole fungicide was applied July 20 as a kernel smut prevention treatment. The field was harvested September 16 yielding 170 bu/acre and milling 61/68. The average field moisture was 17%. The total irrigation was 30 acre-inches and total rainfall was 5.25 inches.

Lee County

The 97-acre field was located just west of Moro on 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 0-50-90-10 lbs/acre (N-P_2O_5-K_2O-Zn) was applied according to the soil sample analysis. The variety Diamond treated with CruiserMaxx Rice seed treatment was drill-seeded at 80 lbs/acre on May 7. Command and Gambit herbicide were applied on May 19 as pre-emergence herbicides. Emergence was observed on May 18 with 20 plants/ft^2. Sharpen and Permit Plus were applied on June 3 as a post-emergence herbicide application. Based on N-STaR recommendations, N fertilizer in the form of urea plus an approved NBPT product was applied at 210 lbs/acre on June 18. The permanent flood was delayed past optimum timing due to levee gate installation. Based on the GreenSeeker response index midseason N fertilizer was applied at 100 lbs/acre on July 5. The field did not reach treatment levels for disease or stink bugs. The field was harvested on September 29 with a disappointing yield of 152 bu/acre and a milling yield of 57/68. The average harvest moisture was 12%. Total irrigation was 28 acre-in/acre and total rainfall was 10.4 inches.

Lincoln/Jefferson County

The 48-acre no-till furrow-irrigated rice (FIR) field was located just west of Pine Bluff on Sharkey clay soil. The previous crop was soybean. According to the soil test a pre-plant fertilizer of 12-40-0-10-1 lbs/acre (N-P_2O_5-K_2O-Zn-S) was applied prior to planting. The cultivar RT 7301, treated with the company's standard seed treatment was

drill-seeded on May 7. The seeding rate was 23 lbs/acre. Glyphosate, Command, and Gambit herbicides were applied at planting. The rice emerged on May 28 with 6 plants/ft^2. RiceBeaux and Facet L were applied as post-emergence herbicides on June 4. Using the N-STaR recommendation, N fertilizer in the form of urea with an approved NBPT product was applied at 170 lbs/acre on June 20. The second N application was applied July 3 at 170 lbs/acre. The third N application was made on July 10 at 100 lbs/acre. The late-boot N application was made on July 25 at 65 lbs/acre. Based on GreenSeeker response index during midseason growth stages N levels were adequate. The field was treated for kernel smut prevention with the fungicide propiconazole on July 23. The field was harvested late on November 13 yielding 183 bu/acre with a milling yield of 61/68. The average harvest moisture was 15%. Total irrigation water use was 28 acre-in/acre and total rainfall was 19.05 inches.

Lonoke County

The 42-acre contour field was located north of Lonoke on a Callaway silt loam soil. Spring conventional tillage practices were utilized and pre-plant fertilizer was applied at 0-0-60 lb/acre (N-P_2O_5-K_2O) according to the soil test. Glyphosate herbicide was used as a burndown on March 20. Glyphosate and Command were applied as a burndown and pre-emergence herbicide on April 16. The cultivar RT 7301 treated with the company's standard seed treatment was drill-seeded at 22 lbs/acre on April 16. Stand emergence was observed on May 15 with 5.4 plants/ft^2. Stam, Facet L, Prowl H^2O, and Permit were applied as post-emergence herbicides on May 14. Nitrogen fertilizer in the form of urea plus NBPT was applied May 18 according to the N-STaR recommendation. Multiple-inlet rice irrigation (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 1 at 65 lbs/acre. The field was harvested on September 12 yielding 201 bu/acre and a milling yield of 61/71. Total irrigation water use was 11.5 acre-in/acre and total rainfall was 14.25 inches.

Monroe County

The 145-acre contour field was located west of Monroe. The soil classification was Dundee and Foley Calhoun Bonn. Spring conventional tillage practices were used for field preparation and based on soil analysis a 0-45-60 lbs/acre (N-P_2O_5-K_2O) was applied May 18. The cultivar RT XP753 treated with the company's standard seed treatment was drill-seeded at 22 lbs/acre on April 21. Glyphosate and Command herbicide were applied at planting. Emergence was observed on May 27 with 6.4 plants/ft^2. Regiment, Facet L, and Permit Plus were applied as post-emergence herbicides on June 10. Duet and Permit herbicides were applied July 8. Regiment and Facet L herbicides were applied to the levees using a Bowman MudMaster on July 8. Using the N-STaR recommendation, N fertilizer in the form of urea was applied at 270 lbs/acre on June 11. Based on GreenSeeker response index during midseason growth stages, N levels were adequate. Late-boot N fertilizer was applied as urea at 65 lbs/acre on July 22. Propiconazole fungicide was applied as smut prevention on July 16. Stink bugs reached threshold levels and lambda-cyhalothrin was applied on September 16. The field was harvested October 3 yielding 188 bu/acre. The milling yield was 57/70 and the average harvest moisture

was 15%. Total irrigation for the season was 30 acre-in/acre and total rainfall was 13.35 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 46 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 0-0-90-3 lbs/acre (N-P_2O_5-K_2O-Zn). On May 3, the cultivar Diamond with Apron, Maxim, and zinc seed treatments was drill-seeded at 73 lbs/acre. Command herbicide was applied pre-emergence on May 4. Rice emergence was observed on May 14 with a stand count of 16 plants/ft^2. A post-emergence application of Regiment, Facet L, and Permit herbicides were made on May 29. On May 30, the N-STaR recommendation of 240 lbs/acre of urea plus an approved NBPT product was made. Flood-up occurred over the next 4 days using the multiple-inlet rice irrigation (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 lbs/acre on July 7. On July 22, propiconazole fungicide was applied for false smut prevention. The field was harvested on September 21 yielding 180 bu/acre. Moisture at harvest was 17%. The milling yield was 57/69. Total irrigation was 41.7 acre-in/acre and total rainfall for the season was 15.8 inches.

Mississippi County

The precision-graded Mississippi County field was located just north of Keiser on a Sharkey silty clay complex soil. Conventional tillage practices were used for field preparation in the spring. Based on soil test analysis pre-plant fertilizer was applied at 0-40-0-10 (lbs/acre N-P_20_5-K_20-Zn). On April 18, RT 7321 FP treated with the company's standard seed treatment was drill-seeded at 29 lbs/acre. Command and glyphosate were applied on April 18 as pre-emergence and burndown herbicides. Stand emergence was observed on May 6 with 7.5 plants/ft^2. Preface and Prowl H2O herbicides were applied on May 18. Loyant herbicide was applied on levees for pigweed control May 20. Using the N-STaR recommendation, urea in the form of urea plus an approved NBPT product was applied at 300 lbs/acre. The late-boot urea application of 70 lbs/acre was made on July 12. Propiconazole fungicide was applied July 14 for smut prevention. The field was harvested September 8 yielding 210 bu/acre with a milling yield of 62/71. The harvest moisture was 12%. Total irrigation use was 30 acre-in/acre and rainfall totaled 9.65 inches.

Table 1. Agronomic information for fields enrolled in the 2020 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[a]	Harvest Moisture
Drew	RT 7521 FP	40	Soybean	23	7	4-May	18-May	12-Sep	184	63/69	16%
Jackson	RT 753	140	Soybean	25	7	17-April	5-May	13-Sep	215	62/70	18%
Lawrence	CLL 15	35	Soybean	80	19	30-Apr	5-May	16-Sep	170	61/68	17%
Lee	Diamond	97	Soybean	80	20	7-May	18-May	29-Sep	152	57/68	12%
Lincoln/ Jefferson	RT 7301	48	Soybean	23	6	7-May	28-May	13-Nov	183	61/68	12%
Lonoke	RT 7301	42	Soybean	22	6	16-Apr	15-May	12-Sep	201	61/71	15%
Mississippi	RT 7321 FP	68	Soybean	29	8	18-Apr	6-May	8-Sep	210	62/71	12%
Monroe	RT XP753	145	Fallow	22	6	21-May	27-May	3-Oct	188	57/70	15%
Woodruff	Diamond	46	Soybean	73	16	3-May	14-May	21-Sep	180	57/69	17%
Average	------	**73**	------	[b]42	[c]11	**14-May**	**15-May**	**14-Sep**	**187**	**60/69**	**15.%**

[a] Milling yield: % Head rice (whole white grains) / % Total white rice (whole grains + broken grains).
[b] Seeding rates averaged 78 lbs/acre for conventional cultivars and 24 lbs/acre for hybrid cultivars.
[c] Stand density averaged 18 plants/ft^2 for conventional cultivars and 7 plants/ft^2 for hybrid cultivars.

Table 2. Soil test results, fertilization program, and soil classification for fields enrolled in the 2020 Rice Research Verification Program.

Field Location by County	Soil Test				Applied Fertilizer (lbs/acre)			Soil Classification
		lbs/acre						
	pH	P	K	Zn	Mixed Fertilizer [a] N-P-K-Zn [b]	N-Star Urea (46%N) rates and timing [c, d]	Total N rate (lbs N/acre)	
Drew	6.0	29	535	4.2	18-46-0-0	165-165-100-65	228[e]	Perry Clay
Jackson	6.4	64	259	15.4	18-46-0-0	160-160-100-65	223[e]	Amagon & Forestdale silt loam
Lawrence	7.0	36	220	39.6	0-50-90-0	260-100-0	166	Jackport silty clay
Lee	7.4	55	182	3.9	0-50-90-10	210-100	143	Henry silt loam
Lincoln/ Jefferson	6.8	19	756	5.9	12-40-0-10	170-170-100-65	232[e]	Perry Clay
Lonoke	6.3	68	258	4.2	0-0-60-0	260-65-0	150	Callaway silt loam
Mississippi	7.3	43	364	7.8	12-40-0-10	300-70-0	103	Sharkey-Steel silty clay complex
Monroe	6.8	44	247	3.9	0-45-60-0	270-0-65-1	154	Foley Calhoun Bonn Dundee silt
Woodruff	6.1	60	165	5.6	0-0-90-3	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: preflood – 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 preflood N recommendation in all fields was treated with an approved NBPT product to minimize N loss due to ammonia volatilization.

[e] Row rice fields received additional seasonal N exceeding the N-Star recommendation by 46 lbs.

Table 3. Herbicide rates and timings for fields enrolled in the 2020 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]
Drew	Glyphosate (1 qt) + Command (16 oz) + Sharpen (2 oz)	Preface (4 oz) + Facet L (25 oz) + Prowl (2.1 pt) FB Command (18 oz) + Preface (6 oz) + NIS (16 oz) FB Regiment (0.63 oz) + Preface (6 oz) + Triple Play (16 oz)
Jackson	Command (12.8 oz) + Glyphosate (32 oz)	Prize/Quinclorac (12.8 oz) + Prowl H_2O (2.1 pt) + Command (6 oz) FB Command (6 oz) FB Loyant Spot Treatment (8 oz)
Lawrence	Roundup PowerMaxx (1 qt)	Command (12.8) + Bolero (2 pt) + Prowl H_2O (2.1 pt) FB Regiment (0.5 oz) +Triple Play Trim Only (12.8 oz)
Lee	Glyphosate (40 oz) + FirstShot (0.5 oz)	Command (12.8 oz) + (Gambit (1 oz) FB Sharpen (1 oz) + Permit Plus (0.75 oz) + COC (1 pt)
Lincoln/ Jefferson	Glyphosate (32 oz) + Command (16 oz) + Gambit (1.5 oz)	RiceBeaux (4 qt) + Facet (1 qt)
Lonoke	Glyphosate (42 oz) FB Glyphosate (42 oz) + Command (1 pt)	Stam (1 qt) + Facet (1 qt) + Permit (1 oz) + Prowl H_2O (2.1 pt)
Mississippi	Glyphosate (40 oz) + Command (20 oz)	Preface (4 oz) + Prowl H_2O (2.1 pt) FB Loyant Levees only (10 oz)
Monroe	Glyphosate (32 oz) + Command (16 oz)	Regiment (0.4 oz) + Facet (32 oz) + Permit Plus (0.75 oz) + Triple Play (12.8 oz)
Woodruff	Command (16 oz)	Regiment (0.4 oz) + Facet (32 oz) + Permit (1 oz) + Triple Play (16 oz)

[x] 'FB' = 'followed by' and is used to separate herbicide application events; COC = Crop Oil Concentrate; NIS = Non-Ionic Surfactant; Triple Play = Organo-Silicone Surfactant

Table 4. Seed treatments used and foliar fungicide and insecticide applications made on fields enrolled in the 2020 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
Drew	RTST	------	------	------	-------
Jackson	RTST	------	------	------	------
Lawrence	CruiserMaxx Rice (7 fl oz) +Zinc + Release	Propiconazole (6 oz)	------	------	------
Lee	CruiserMaxx Rice (7 fl oz)	------	------	------	------
Lincoln/ Jefferson	RTST	Propiconazole (6 oz)	------	------	------
Lonoke	RTST	------	------	------	------
Mississippi	RTST	Propiconazole (6 oz)	------	------	------
Monroe	RTST	Propiconazole (6 oz)	------	------	Lambda-Cyhalothrin (2.1 oz)
Woodruff	Zinc, Apron XL LS (0.64 oz/cwt Maxim 4 FS (.8 oz/cwt	Propiconazole (6 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.

Table 5. Rainfall and irrigation information for fields enrolled in the 2020 Rice Research Verification Program.

Field Location by County	Rainfall (inches)	Irrigation[z] (acre-in/acre)	Rainfall + Irrigation (inches)
Drew	17.5	26.0	43.5
Jackson	19.5	30.5	50.0
Lawrence	5.3	28.0	33.3
Lee	10.4	30.0*	40.4
Lincoln/ Jefferson	20.9	26.0	46.9
Lonoke	14.3	11.5	25.8
Mississippi	9.7	30.0*	39.7
Monroe	13.4	30.0*	43.4
Woodruff	15.9	41.7	57.6

[z] Not all fields were equipped with flow meters to monitor water use for irrigation. Therefore, the historical average irrigation amount in fields with flow meters 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 2020 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 9 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 2020 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 $436.13/acre for Lee County to $744.77 for Drew County, while operating costs per bushel ranged from $2.56/bu for Jackson County to $4.05/bu for Drew County. Total costs per acre (operating plus fixed) ranged from $542.39/acre for Lee County to $826.44/acre for Drew County, and total costs per bushel ranged from $3.11/bu for Jackson County to $4.49/bu for Drew County. Returns above operating costs ranged from $340.53/acre for Drew County to $720.53/acre for Jackson County, and returns above total costs ranged from $258.86/acre for Drew County to $600.40/acre for Jackson 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 2020 RRVP was 187 bu/acre but ranged from 152 bu/acre for Lee County to 215 bu/acre for Jackson County. An Arkansas average long-grain cash price of $5.76/bu was estimated using USDA, National Agricultural Statistics Service (NASS) US long-grain price data for the months of August through October. The 2020 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, a standard milling yield of 55/70 for long-grain rice, and 2020 loan values for whole kernels ($11.10/cwt; $5.00/bu) and broken kernels ($6.45/cwt; $2.90/bu). Estimated long-grain prices adjusted for milling yield varied from $5.74/bu in Lee County to $5.94/bu in Mississippi County (Table 7).

The average operating expense for the 9 RRVP fields was $594.77/acre (Table 7). Seed expenses accounted for the largest share of operating expenses on average (21.4%) followed by post-harvest expenses (19.0%), fertilizers & nutrients (18.6%), and chemicals (16.1%). Although seed's share of operating expenses was 21.4% across the 9 fields, it's average cost and share of operating expenses varied depending on whether a herbicide tolerant hybrid was used ($186.75/acre; 26.1% of operating expenses), a conventional (non-herbicide tolerant) hybrid was used ($147.75/acre; 24.0% of operating expenses), a herbicide-tolerant non-hybrid (pureline) variety was

used ($109.65/acre; 20.5% of operating expenses, or a non-herbicide tolerant non-hybrid (pureline) variety was used ($36.38/acre; 7.9% of operating expenses).

The average return above operating expenses for the 9 fields was $496.13/acre and ranged from $340.53/acre for Drew County to $720.53/acre for Jackson County. The average return above total specified expenses for the 9 fields was $394.42/acre and ranged from $258.86/acre for Drew County to $600.40/acre for Jackson 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 2020 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)
Drew	744.77	4.05	340.53	81.67	826.44	258.86	4.49
Jackson	549.36	2.56	720.53	120.13	669.49	600.40	3.11
Lawrence	533.89	3.14	456.79	97.44	631.33	359.34	3.71
Lee	436.13	2.87	436.92	106.25	542.39	330.67	3.57
Lincoln-Jefferson	667.14	3.65	399.30	76.43	743.57	322.86	4.06
Lonoke	549.60	2.73	639.23	95.77	645.37	543.46	3.21
Mississippi	683.84	3.26	562.61	113.98	797.82	448.63	3.80
Monroe	697.29	3.71	393.46	115.51	812.80	277.95	4.32
Woodruff	490.88	2.73	548.23	108.22	599.11	440.00	3.33
Average	**594.77**	**3.19**	**499.73**	**101.71**	**696.48**	**398.02**	**3.73**

Table 7. Summary of Revenue and Expenses per Acre for fields enrolled in the 2020 Rice Research Verification Program.

Receipts	Drew	Jackson	Lawrence	Lee	Lincoln-Jefferson
Yield (bushels)	184	215	170	152	183
Price Received ($/bushel)	5.90	5.91	5.83	5.74	5.83
Total Crop Revenue	**1085.30**	**1269.89**	**990.68**	**873.06**	**1066.43**
Operating Expenses					
Seed	163.53	155.50	109.65	43.35	140.07
Fertilizers & Nutrients	141.09	101.47	106.87	105.90	146.04
Chemicals	173.37	58.25	83.79	61.21	118.74
Custom Applications	66.40	8.00	36.80	32.80	67.20
Diesel Fuel	13.36	15.18	13.65	17.47	12.03
Repairs & Maintenance	18.79	23.06	19.60	21.32	17.94
Irrigation Energy Costs	34.25	40.18	36.88	39.52	34.25
Labor, Field Activities	5.98	6.76	7.31	8.42	5.53
Other Inputs & Fees, Pre-harvest	16.96	11.23	16.74	14.42	14.90
Post-harvest Expenses	111.04	129.75	102.60	91.73	110.44
Total Operating Expenses	**744.77**	**549.36**	**533.89**	**436.13**	**667.14**
Returns to Operating Expenses	**340.53**	**720.53**	**456.79**	**436.92**	**399.30**
Capital Recovery & Fixed Costs	81.67	120.13	97.44	106.25	76.43
Total Specified Expenses [z]	**826.44**	**669.49**	**631.33**	**542.39**	**743.57**
Returns to Specified Expenses	**258.86**	**600.40**	**359.34**	**330.67**	**322.86**
Operating Expenses/Yield Unit	4.05	2.56	3.14	2.87	3.65
Total Expenses/Yield Unit	4.49	3.11	3.71	3.57	4.06

[z] 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 2020 Rice Research Verification Program (Continued).

Receipts	Lonoke	Mississippi	Monroe	Woodruff	Average
Yield (bushels)	201	210	188	180	187
Price Received ($/bushel)	5.91	5.94	5.80	5.77	5.85
Total Crop Revenue	**1188.83**	**1246.46**	**1090.75**	**1039.11**	**1094.50**
Operating Expenses					
Seed	146.16	209.96	149.28	29.41	127.43
Fertilizers & Nutrients	77.50	116.89	112.80	89.97	110.95
Chemicals	87.53	61.86	131.21	84.96	95.66
Custom Applications	36.80	56.00	69.60	51.20	47.20
Diesel Fuel	16.66	20.68	22.67	18.59	16.70
Repairs & Maintenance	19.31	22.94	22.44	22.70	20.90
Irrigation Energy Costs	15.20	39.52	39.52	54.93	37.14
Labor, Field Activities	6.98	9.14	9.98	9.57	7.74
Other Inputs & Fees, Pre-harvest	22.16	20.11	26.33	20.93	18.20
Post-harvest Expenses	121.30	126.74	113.46	108.63	112.85
Total Operating Expenses	**549.60**	**683.84**	**697.29**	**490.88**	**594.77**
Returns to Operating Expenses	**639.23**	**562.61**	**393.46**	**548.23**	**499.73**
Capital Recovery & Fixed Costs	95.77	113.98	115.51	108.22	101.71
Total Specified Expenses [z]	**645.37**	**797.82**	**812.80**	**599.11**	**696.48**
Returns to Specified Expenses	**543.46**	**448.63**	**277.95**	**440.00**	**398.02**
Operating Expenses/Yield Unit	2.73	3.26	3.71	2.73	3.19
Total Expenses/Yield Unit	3.21	3.80	4.32	3.33	3.73

[z] 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 2020 Rice Research Verification Program.

County	Rice Type	Seed	Fertilizers & Nutrients	Herbicides	Insecticides	Fungicides and Other Inputs	Diesel Fuel	Irrigation Energy Costs
Drew	RT 7521 FP	163.53	141.09	173.37	---	---	13.36	34.25
Jackson	RT 753	155.50	101.47	58.25	---	---	15.18	40.18
Lawrence	CLL15	109.65	106.87	79.29	---	4.50	13.65	36.88
Lee	Diamond	43.35	105.90	61.21	---	---	17.47	39.52
Lincoln-Jefferson	RT 7301	140.07	146.04	114.24	---	4.50	12.03	34.25
Lonoke	RT 7301	146.16	77.50	87.53	---	---	16.66	15.20
Mississippi	RT 7321 FP	209.96	116.89	52.46	---	9.41	20.68	39.52
Monroe	XP 753	149.28	112.80	124.42	2.30	4.50	22.67	39.52
Woodruff	Diamond	29.41	89.97	78.96	---	6.00	18.59	54.93
Average	**---**	**127.43**	**110.95**	**92.19**	**2.30**	**5.78**	**16.70**	**37.14**