DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

2023

University of Arkansas

Rice Research Verification Program

The Rice Research Verification Program is funded by Arkansas rice producers through check-off monies administered by the Arkansas Rice Research and Promotion Board.

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

Table of Contents

RICE RESEARCH VERIFICATION PROGRAM, 2023

Conducted by:
Ralph Mazzanti, Program Associate – Rice Research Verification Program
Dr. Jarrod Hardke, Professor and Rice Extension Agronomist
Dr. Brad Watkins, Professor – Agricultural Economics

Acknowledgments:

Cooperating Rice Producers:

Kim Ellington	Kevin Goble	Haynie Farms
Nathan Pribble	Derick Hallum	DG Farms
Michael Oltman	Nacho Palmnerrin	John Hamilton

Cooperating County Extension Agents:

Clark County – Amy Simpson
Cross County – Jenna Martin
Drew County – Scott Hayes
Jefferson County – Brady Harmon
Mississippi County – Ethan Brown & Alan Beach
Pulaski County – Andrew Bolton
Phillips County – Tucker Von Kanel & Shawn Payne
Woodruff County – Brett Gordon
White County – Jerrod Haynes

Cooperative Extension Service:
Dr. Bob Scott, Senior Associate Vice President for Agriculture-Extension and Director, Cooperative Extension Service
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. Camila Nicolli, Extension Plant Pathologist

Agricultural Experiment Station:
Dr. Jeff Edwards, 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. Xueyan Sha, Professor – Crop, Soil, and Environmental Sciences
Dr. Trenton Roberts, Associate Professor – Crop, Soil, and Environmental Sciences

Arkansas Rice Research and Promotion Board:

Jim Whitaker (Chairman)
Jeff Rutledge (Vice Chairman)
David Petter (Secretary/Treasurer)
Joe Christian
Jay Coker
David Gairhan
John King
Roger Pohlner
Wayne Wiggins

INTRODUCTION

The 2023 growing season was the fortieth 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.

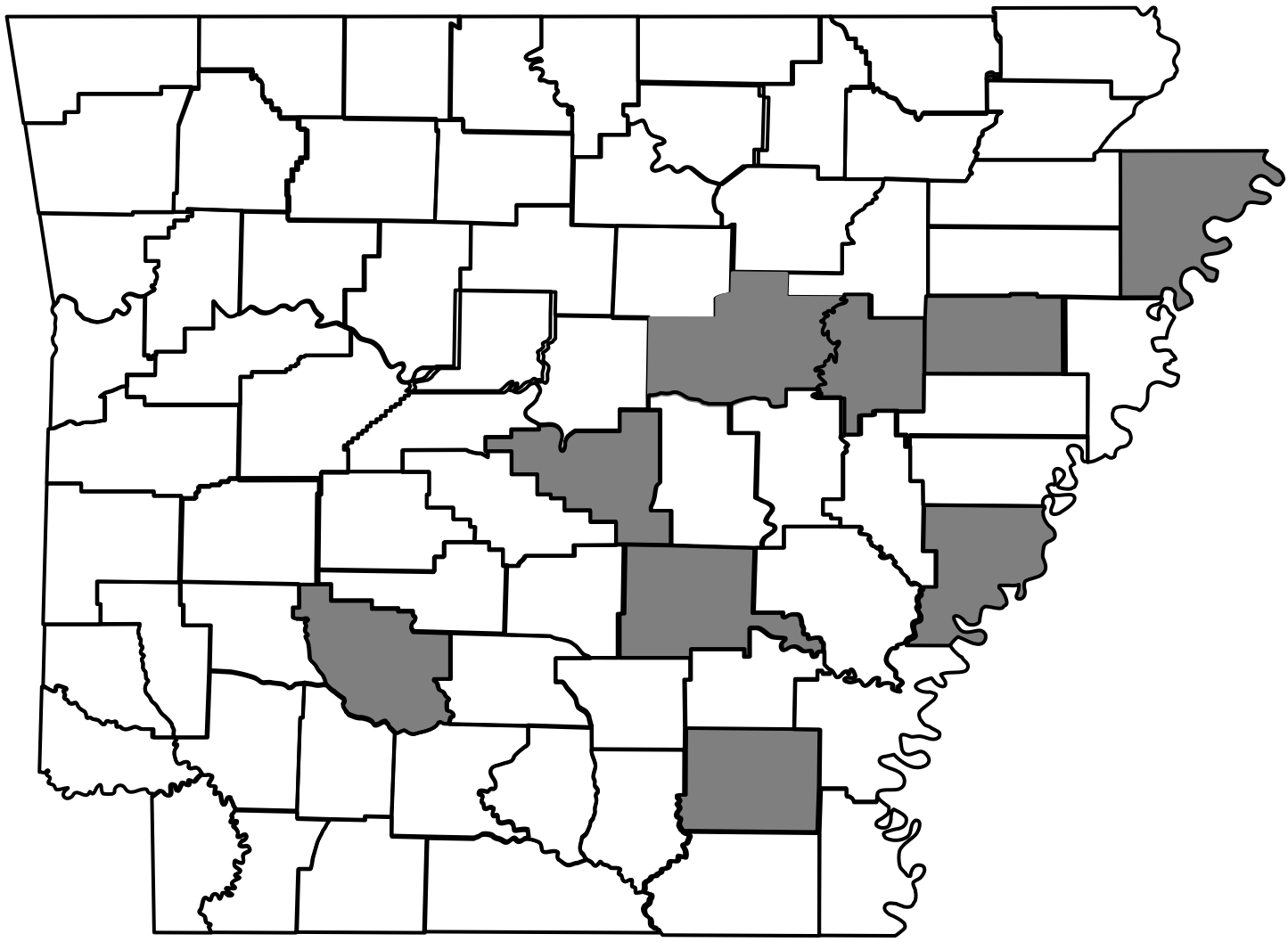
6. To provide training and assistance to county agents and growers with limited expertise in rice production.

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 2023. The fields were located on commercial farms ranging in size from 30 to 128 acres. The average field size was 68 acres.

Counties participating in the program during 2023 included Clark, Cross, Drew, Jefferson, Mississippi, Pulaski, Phillips, Woodruff and White (Figure 1).

The nine rice fields totaled 615 acres enrolled in the program. Six different cultivars were seeded: Dyna-Gro DG263L [2 fields]; RiceTec RT 7521 FP [2 fields]; RT 7321 FP [4 fields]; and Titan [1 field]. University of Arkansas System Division of Agriculture Cooperative Extension Service (UADA CES) 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 UADA 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 2023 Rice Research Verification Program Fields.



FIELD REVIEWS

Verification Coordinator – Ralph Mazzanti

Clark County

The Clark County field was located south of Arkadelphia on an Una and Gurdon silty clay loam soil. The field is zero grade with continuous rice and no tillage practices were used for spring preparation. The field consisted of 41 acres. The chosen cultivar was RT 7321 FP treated with the company's standard seed treatment. The field was drill-seeded at 25 lbs/acre on April 17. Emergence was observed on May 1 with a stand count of 3.2 plants/ft^2. According to the soil test a pre-plant fertilizer at 0-40-90-5 (N-P_2O_5-K_2O) lbs/acre was applied in the spring. A 21-21-21 (N-P_2O_5-K_2O) lbs/acre blend was applied for soil maintenance as litter. Command, Sharpen, FirstShot, and Glyphosate were applied as pre-emergence and burn-down herbicides at planting. Postscript, Command, and Facet L were applied as overlapping and post-emergence herbicides on May 19. Regiment and RiceBeaux herbicides were applied May 30 for weed escapes. N-STaR (Nitrogen Soil Test for Rice) was taken on the field. Nitrogen in the form of urea plus an approved NBPT was applied at 240 lbs/acre on May 20 followed by 70 lbs/acre urea on July 12. Surface water was adequately maintained with the use of a re-lift pump. Using Trimble GreenSeeker technology, the N response levels remained adequate throughout the growing season. Having a kernel smut history, Quilt Xcel was applied on July 18. The field was harvested on September 4 yielding 136 bu/ac and a milling yield of 37/64. The disappointing yield was believed to be from competition of weedy rice. The average harvest moisture was 18%. Total irrigation was 5.5-acre-inches and total rainfall was 18.57 inches.

Cross County

The contour Crittenden County field was located just north of Hickory Ridge on a Henry silt loam soil. Conventional tillage practices were used in the spring by running a disc and land plane. The field consisted of 116 acres and the previous crop grown was soybean. The cultivar chosen was RT 7321 FP treated with the company's standard seed treatment. The field was drill-seeded at 22 lbs/ac planted April 12. Command, Preface, Roundup, and League herbicides were applied at planting on April 12. Emergence was observed on May 1 with a stand count of 6 plants/ft^2. According to the soil test a pre-plant fertilizer at a rate of 12-42-85-10 (N-P_2O_5-K_2O-Zn) lbs/acre was applied in the spring. Preface and Propanil were applied as post-emergence herbicides on May 5. N-STaR was utilized on the field. Nitrogen in the form of urea plus an approved NBPT was applied at 300 lbs/acre on May 15, followed by 65 lbs/acre on July 14. Using Trimble GreenSeeker, the N response levels remained adequate throughout the season. An adequate flood was maintained throughout the growing season. Propiconazole fungicide was applied on July 10 due to a history of smut. The field was harvested on August 24 yielding 195 bu/ac with a milling yield of 62/72. The average harvest moisture was 18%. Total irrigation was 28.4 acre-inches and rainfall totaled 21.1 inches.

Drew County

The Drew County furrow-irrigated field was located just west of Winchester on a Perry and Portland clay soil. The field consisted of 112 acres and the previous crop was soybean. The cultivar chosen was RT 7521 FP treated with the company's standard seed treatment in the spring, no tillage practices were used. The field was drill-seeded at 26 lbs/acre on May 4. Emergence was observed on May 13 with a stand count of 11 plants/ ft^2. According to the soil test pre-plant fertilizer at a rate of 18-46-0 ($N-P_2O_5-K_2O$) lbs/acre was applied May 23. Glyphosate, Command, Sharpen, and Preface herbicides were applied at planting. Facet and Propanil herbicides were applied as post-emergence herbicides on June 7. N-STaR was taken on the field. Nitrogen in the form of urea plus an approved NBPT was applied at 100 lbs/acre on May 25, followed by 100 lbs/acre on June 1, followed by 100 lbs/acre on June 7. The late-boot N application was made on July 20 at 70 lbs/acre. Using Trimble GreenSeeker, the N response levels remained adequate throughout the season. Intermittent flushing was utilized for irrigation. The field was harvested September 15 yielding 175 bu/acre and a milling yield of 48/69. The average harvest moisture was 14%. Total irrigation was 28.8 ac-in/ac and total rainfall was 10.9 inches.

Jefferson County

The 128-acre Jefferson County field was located just north of Reydell on a Dundee silt loam soil. No tillage practices were made in the spring. No pre-plant fertilizer was necessary according to the soil sample analysis. The field was drill-seeded March 29 with DG263L at 45 lbs/acre. The seed was treated with the company's standard seed treatment. Rice emergence was observed on April 18 at 9 plants/ft^2. Command, Sharpen, and Roundup were used as pre-emergence and burndown herbicides on April 1. Command was applied as an overlapping residual on April 11. Propanil and Facet were applied as post-emergence herbicides on May 22. Using the N-STaR recommendation N fertilizer in the form of urea plus NBPT was applied at 200 lbs/acre on May 23. The mid-season N application was applied June 19 at 100 lbs/acre. GreenSeeker technology was utilized during midseason growth stages to monitor the crop's N level. Multiple-inlet rice irrigation (MIRI) was utilized to achieve a more efficient permanent flood. Endigo insecticide was applied for stink bugs on July 14. The field was harvested September 5. The yield was 190 bu/acre. The milling yield was 36/64 and average harvest moisture was 15%. Total irrigation use was 32.6 acre-inches and rainfall totaled 15.1 inches.

Mississippi County

The 32-acre furrow-irrigated field was located just north of Denwood on an Alligator Clay soil. No tillage practices were utilized. Gramoxone was applied March 20 as a burndown herbicide. The cultivar RT 7321 FP treated with the company's standard seed treatment was drill-seeded at 22 lbs/acre on April 19. A pre-plant fertilizer at 0-46-0 ($N-P_2O_5-K_2O$) lbs/acre was applied according to the soil test. Glyphosate, Command, Sharpen, and Facet were applied as burndown and pre-emergence herbicides at planting. Stand emergence was observed on May 5 with 5 plants/ft^2. Nitrogen fertilizer in the form

of urea plus NBPT was applied at 200 lbs/acre on May 15. The second application of urea plus NBPT was applied at 100 lbs/acre on May 25. GreenSeeker technology was utilized during midseason growth stages to monitor the crop's N level. The late-boot urea application was made on July 27 at 70 lbs/acre. The field required no treatments for disease or insects. The field was harvested on September 12 yielding 193 bu/acre and a milling yield of 48/69. Total irrigation was 28.4 acre-in/acre and total rainfall was 14.9 inches.

Phillips County

The 29-acre furrow-irrigated field was located north of Marvell. The soil classification is a Callaway silt loam. Pre-plant fertilizer at a rate of 0-60-60-10 (N-P_2O_5-K_2O-Zn) lbs/acre was applied in the spring. No tillage practices were used for field preparation. Titan, a conventional medium grain variety was chosen treated with zinc and CruiserMaxx Rice. The field was drill-seeded at 75 lbs/acre on April 6. Command, Sharpen, and Glyphosate were applied at planting as pre-emergence and burndown herbicides. Emergence was observed on April 12 with 19.4 plants/ft^2. Command was applied as an overlapping residual on May 16. Sharpen herbicide was applied May 31. N-STaR was taken on the field. Nitrogen fertilizer in the form of urea was applied at 100 lbs/acre on May 22 followed by 100 lbs/acre on May 31. Another 100 lbs/acre was applied at mid-season on July 10. GreenSeeker technology was utilized during growth stages to monitor the crop's N level. The field was harvested September 7 yielding 206 bu/acre. The milling yield was 46/67 and the average harvest moisture was 19%. Total irrigation for the season was 63.4 acre-in/acre and total rainfall was 12.45 inches.

Pulaski County

The precision-graded Pulaski County field was located just west England on a Dewitt silty clay loam soil. The field was no-till and based on soil test analysis, pre-plant fertilizer was applied at 0-50-60 (N-P_2O_5-K_2O) lbs/acre. On April 30, RT 7321 FP treated with the company's standard seed treatment was drill-seeded at 23 lbs/acre. Command and Roundup were applied at planting as pre-emergence and burndown herbicides. Stand emergence was observed on May 11 with 8.3 plants/ft^2. Preface and Facet herbicides were applied on May 20. Nitrogen fertilizer in the form of urea plus NBPT was applied at 270 lbs/acre on May 20, according to the N-STaR recommendation. The late-boot urea application of 80 lbs/acre was made on July 11. Stink bugs reached treatment level and the field was sprayed with Endigo insecticide on August 16. The field was harvested September 23 yielding 187 bu/acre with a milling yield of 43/64. The harvest moisture was 13%. Total irrigation use was 30 acre-in/acre and rainfall totaled 12.0 inches.

White County

The 40-acre contour field was located southeast of Higginson on a Calhoun silt loam soil. Conventional tillage practices were utilized, and pre-plant fertilizer was applied at a rate of 0-30-90-7.5 (N-P_2O_5-K_2O-Zn) lbs/acre according to the soil test. Command, Sharpen, and Preface were applied as pre-emergence herbicides on April 13. The

cultivar RT 7321 FP treated with the company's standard seed treatment was drill-seeded at 22 lbs/acre on April 12. Stand emergence was observed April 26 at 6 plants/ft^2. Duet herbicide was applied May 9. Command and Preface were applied as overlapping and post-emergence herbicides on May 24. Nitrogen fertilizer in the form of urea plus NBPT was applied May 26 at 300 lbs/acre according to the N-STaR recommendation. Multiple-inlet rice irrigation (MIRI) was utilized to achieve a more efficient permanent flood. GreenSeeker technology was utilized during midseason growth stages to monitor the crop's N level. The late-boot N fertilizer application was made on July 6 at 70 lbs/acre. Sheath blight reached treatment level and Amistar Top fungicide was applied on July 2. Stink bugs exceeded threshold levels and Endigo insecticide was applied on August 2. The field was harvested on September 4 yielding 236 bu/acre and a milling yield of 51/67. The harvest moisture averaged 18%. Total irrigation usage was 12.4 acre-inches and total rainfall was 13.65 inches.

Woodruff County

The contour field was located south of McCrory. The soil type is a McCrory fine sand soil. Spring conventional tillage practices were used for field preparation and based on soil analysis a pre-plant fertilizer of 0-46-120 ($N-P_2O_5-K_2O$) lbs/acre was applied April 10 based on soil test analysis. On April 20, DG263L treated with the company's standard seed treatment was drill-seeded at 55 lbs/acre. Command and Facet L were applied at planting as pre-emergence herbicides. Stand emergence was observed on May 5 with 7.6 plants/ft^2. Permit Plus and Propanil herbicides were applied May 22. Nitrogen fertilizer in the form of urea plus NBPT was applied at 260 lbs/acre on May 25 in accordance with the N-STaR recommendation. The mid-season urea application of 100 lbs/acre was made on June 29. No disease or insect treatments were necessary. The field was harvested September 15 yielding 194 bu/acre with a milling yield of 58/69. The harvest moisture was 14%. Total irrigation use was 60.5 acre-in/acre and rainfall totaled 12.1 inches.

Table 1. Agronomic information for fields enrolled in the 2023 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
Clark	RT 7321 FP	40	Rice	25	3	17-April	1-May	4-Sept	136	37/64	18%
Cross	RT 7321 FP	116	Soybean	22	6	12-April	1-May	24-Aug	195	62/72	18%
Drew	RT 7521 FP	112	Soybean	22	11	4-May	13-May	15-Sept	175	48/69	14%
Jefferson	DG263L	128	Soybean	45	9	29-March	18-April	5-Sept	190	36/64	15%
Mississippi	RT 7321 FP	32	Soybean	22	8	12-April	27-April	26-Sept	193	48/69	18%
Phillips	Titan	29	Soybean	75	19	6-May	12-May	7-Sept	206	46/67	19%
Pulaski	RT 7521 FP	56	Rice	22	10	12-May	28-May	29-Aug	187	43/64	18%
White	RT 7321 FP	40	Soybean	22	6	12-April	26-April	4-Sept	236	51/67	18%
Woodruff	DG263L	61	Corn	55	7	20-April	5-May	15-Sept	194	58/69	14%
Average	------	**68**	------	34[b]	9[c]	**20-Apr**	**4-May**	**7-Sep**	**190**	**48/67**	**17%**

[a] Milling yield: % Head rice (whole white grains) % Total white rice (whole grains + broken grains).
[b] Seeding rates averaged 58 lbs/acre for conventional cultivars and 23 lbs/acre for hybrid cultivars.
[c] Stand density averaged 12 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 2023 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 (lbs N/acre)	
		P	K	Zn				
Clark	5.5	20	160	3.6	0-40-90-5	240-0-70	143	Una-Gurdon Silt Clay Loam
Cross	6.9	70	154	9.5	12-42-85-10	300-0-60	166	Henry Silt Loam
Drew	6.2	24	842	6.4	18-46-0-0	(100-100-100)-0-70[e]	170	Perry-Portland Clay
Jefferson	7.8	67	519	5.6	0-0-0-0	200-100-0	138	Dundee Silt Loam
Mississippi	7.0	38	786	6.2	0-46-0-0	(200-100)-0-70[e]	170	Alligator Clay
Phillips	7.4	30	236	4.2	0-60-60-10	(100-100)-100-0[e]	138	Loring-Memphis-Collins
Pulaski	6.1	36	516	5.0	0-50-60-0	270-0-80	161	Perry Clay
White	6.2	68	249	9.3	0-30-90-7.5	300-0-70	170	Calhoun-Henry Silt Loam
Woodruff	6.5	44	106	11.0	0-46-120-0	260-100-0	166	McCrory Fine Sand

[a] Column represents regular pre-plant applications.
[b] N=nitrogen, P=phosphorus (P_2O_5), K=potassium (K_2O), 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. Numbers in parentheses represent early season urea applications for furrow-irrigated rice in place of the preflood application for flooded rice.

Table 3. Herbicide rates and timings for fields enrolled in the 2023 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]
Clark	Command (16 oz) + Glyphosate (32 oz) + Sharpen (2 oz) + FirstShot (5 oz)	Postscript (5 oz) + Command (16 oz) + Facet L (43 oz) fb Regiment (0.6 oz) + RiceBeaux (3 qts) + Triple Play (1 pt)
Cross	Preface (5 oz) + Command (16 oz) + Roundup (32 oz) + League (6.4 oz)	Propanil (3 qts) + Postscript (5 oz)
Drew	Command (24 oz) + Roundup (26 oz) + Sharpen (3 oz) + Preface (4 oz)	Command (10 oz) + Preface (5 oz)
Jefferson	Command (16 oz) + Sharpen (2 oz) + Glyphosate (32 oz)	Facet L (32 oz) + Propanil (4 qts)
Mississippi	Command (16 oz) + Glyphosate (32 oz) + Sharpen (2 oz) + Quinstar (12 oz)	Propanil (4 qts) + Prowl (2.1 pts)
Pulaski	Command (16 oz) + Glyphosate (32 oz) + Sharpen (2 oz)	Prowl (2.1 pts) + Bolero (4 pts) + Clincher (15 oz)
Phillips	Command (12.8 oz) + Sharpen (2 oz) + Glyphosate (32 oz) fb Command (16 oz)	Sharpen (1 oz)
Woodruff	Command (12.8 oz) + Facet L (32 oz)	Permit Plus (0.75 oz) + Propanil (4 qts)
White	Command (16 oz) + Sharpen (2 oz) + Preface (4 oz) fb Duet (3 qts)	Command (16 oz) + Preface (5 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 2023 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/Armyworms
Clark	RTST	Quilt Xcel (15 oz)	------	------	------
Cross	RTST	Propiconazole (6 oz)	------	------	------
Drew	RTST	------	------	------	------
Jefferson	DGST	-------	------	------	Endigo (5 oz)
Mississippi	RTST	-------	------	------	------
Pulaski	RTST	Amistar Top (14 oz)	------	------	------
Phillips	CruiserMaxx Rice + Zinc	------	------	------	------
Woodruff	RTST	------	------	------	------
White	DGST	Amistar Top (15 oz)	------	------	Endigo (5 oz)

[z] RTST = 'RiceTec Seed Treatment' and DGST = 'Dyna-Gro Seed Treatment'. These abbreviations define those fields with seed treated by RiceTec or Dyna-Gro prior to seed purchase and consist of insecticide and fungicides in addition to other seed treatment products.

Table 5. Rainfall and irrigation information for fields enrolled in the 2023 Rice Research Verification Program.

Field Location by County	Rainfall (inches)	Irrigation[z] (acre-in/acre)	Rainfall + Irrigation (inches)
Clark	18.6	5.5	24.1
Cross	21.2	28.4	49.6
Drew	10.95	30.0[z]	40.95
Jefferson	15.1	32.6	47.7
Mississippi	14.9	26.4	41.3
Pulaski	15.7	26.7	42.4
Phillips	12.45	63.4	75.85
Woodruff	12.1	60.5	72.6
White	13.65	12.4	26.05

[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 2023 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 2023 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 (bu), 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 $568.05/acre for Phillips County to $968.16/acre for Cross County, while operating costs per bushel ranged from $2.76/bushel for Phillips County to $6.27/bushel for Clark County. Total costs per acre (operating plus fixed) ranged from $717.80/acre for Phillips County to $1,129.01/acre for Cross County, and total costs per bushel ranged from $3.48/bu for Phillips County to $7.05/bu for Clark County. Returns above operating costs ranged from $51.09/acre for Clark County to $1,182.75/acre for Phillips County, and returns above total costs ranged from -$54.48/acre for Clark County to $1,032.99/acre for Phillips 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 2023 RRVP was 190 bu/acre but ranged from 136 bu/acre for Clark County to 236 bu/acre for White County. Arkansas average long-grain and medium grain cash prices of $7.19/bu and $8.76/bu, respectively, were estimated using USDA, National Agricultural Statistics Service (NASS) US long grain prices and medium-short grain prices (for rice states other than California) for the months of August through October. A premium or discount was given to each field based on the milling yield observed for each field, standard milling yields of 55/70 for long-grain rice and 58/69 for medium-grain rice, and 2023 loan values for whole kernels ($11.13/cwt for long grain; $10.45/cwt for medium grain) and broken kernels ($6.74/cwt for both long grain and medium grain). Estimated long-grain prices adjusted for milling yield varied from $6.63/bu in Jefferson County to $7.38/bu in Cross County (Table 7). Phillips County was the only county producing medium grain rice, and the estimated milling yield adjusted price for Phillips County was $8.50/bu.

The average operating expense for the 9 RRVP fields was $803.97/acre (Table 7). Fertilizer and nutrient expenses accounted for the largest share of operating expenses on average (19.1%) followed by seed (18.1%), chemicals (17.5%), and post-harvest expenses (14.3%). Although seed's share of

operating expenses was 18.1% across the 9 fields, it's average cost and share of operating expenses varied depending on whether a public non-herbicide tolerant pure-line cultivar was used ($45.75/acre; 8.1% of operating expenses), a proprietary non-herbicide tolerant pure-line cultivar was used ($83.00/acre; 12.21% of operating expenses), or a herbicide-tolerant hybrid was used ($178.46/acre; 20.73% of operating expenses).

The average return above operating expenses for the 9 fields was $557.74/acre and ranged from $51.09/acre for Clark County to $1,182.75/acre for Phillips County. The average return above total specified expenses for the 9 fields was $429.92/acre and ranged from -$54.48/acre for Clark County to $1,032.99/acre for Phillips 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 2023 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)
Clark	852.74	6.27	51.09	105.57	958.31	-54.48	7.05
Cross	968.16	4.96	471.83	160.85	1,129.01	310.98	5.79
Drew	915.98	5.23	311.78	115.06	1,031.04	196.72	5.89
Jefferson	617.55	3.25	641.38	110.72	728.27	530.66	3.83
Mississippi	872.93	4.52	481.11	84.39	957.32	396.73	4.96
Phillips	568.05	2.76	1,182.75	149.75	717.80	1,032.99	3.48
Pulaski	794.45	4.25	470.59	120.64	915.09	349.95	4.89
White	904.05	3.83	751.40	145.74	1,049.79	605.66	4.45
Woodruff	741.84	3.82	657.71	157.67	899.52	500.04	4.64
Average	**803.97**	**4.32**	**557.74**	**127.82**	**931.79**	**429.92**	**5.00**

Table 7. Summary of Revenue and Expenses per Acre for fields enrolled in the 2023 Rice Research Verification Program.

Receipts	Clark	Cross	Drew	Jefferson	Mississippi
Yield (bushels)	136	195	175	190	193
Price Received ($/bushel)	6.65	7.38	7.02	6.63	7.02
Total Crop Revenue	**903.83**	**1439.99**	**1227.76**	**1258.93**	**1354.04**
Operating Expenses					
Seed	204.44	179.91	192.98	74.70	179.91
Fertilizers & Nutrients	177.88	191.93	137.72	93.75	192.68
Chemicals	236.18	145.44	164.98	124.44	133.07
Custom Applications	27.20	56.00	56.00	40.00	88.00
Diesel Fuel	19.65	35.84	16.07	17.67	13.11
Repairs & Maintenance	21.50	26.27	26.90	24.58	23.20
Irrigation Energy Costs	5.39	129.14	136.42	57.26	49.88
Labor, Field Activities	48.77	52.54	48.13	50.46	47.51
Other Inputs & Fees, Pre-harvest	29.64	33.41	31.17	20.04	29.09
Post-harvest Expenses	82.08	117.68	105.61	114.67	116.48
Total Operating Expenses	**852.74**	**968.16**	**915.98**	**617.55**	**872.93**
Returns to Operating Expenses	**51.09**	**471.83**	**311.78**	**641.38**	**481.11**
Capital Recovery & Fixed Costs	105.57	160.85	115.06	110.72	84.39
Total Specified Expenses [z]	**958.31**	**1,129.01**	**1,031.04**	**728.27**	**957.32**
Returns to Specified Expenses	**-54.48**	**310.98**	**196.72**	**530.66**	**396.73**
Operating Expenses/Yield Unit	6.27	4.96	5.23	3.25	4.52
Total Expenses/Yield Unit	7.05	5.79	5.89	3.83	4.96

[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 2023 Rice Research Verification Program (Continued).

Receipts	Phillips	Pulaski	White	Woodruff	Average
Yield (bushels)	206	187	236	194	190
Price Received ($/bushel)	8.50	6.76	7.01	7.21	7.13
Total Crop Revenue	**1750.79**	**1265.03**	**1655.45**	**1399.56**	**1361.71**
Operating Expenses					
Seed	45.75	163.29	179.91	91.30	145.80
Fertilizers & Nutrients	97.13	152.53	173.55	165.76	153.66
Chemicals	74.29	156.60	140.19	92.77	140.88
Custom Applications	0.00	64.00	72.00	36.80	48.89
Diesel Fuel	20.73	17.60	30.99	27.68	22.15
Repairs & Maintenance	27.65	29.82	24.61	27.55	25.79
Irrigation Energy Costs	111.35	24.08	56.20	106.26	75.11
Labor, Field Activities	49.77	47.47	54.17	51.93	50.08
Other Inputs & Fees, Pre-harvest	17.07	26.22	29.99	24.73	26.82
Post-harvest Expenses	124.32	112.85	142.43	117.08	114.80
Total Operating Expenses	**568.05**	**794.45**	**904.05**	**741.84**	**803.97**
Returns to Operating Expenses	**1,182.75**	**470.59**	**751.40**	**657.71**	**557.74**
Capital Recovery & Fixed Costs	149.75	120.64	145.74	157.67	127.82
Total Specified Expenses [z]	**717.80**	**915.09**	**1,049.79**	**899.52**	**931.79**
Returns to Specified Expenses	**1,032.99**	**349.95**	**605.66**	**500.04**	**429.92**
Operating Expenses/Yield Unit	2.76	4.25	3.83	3.82	4.32
Total Expenses/Yield Unit	3.48	4.89	4.45	4.64	5.00

[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 2023 Rice Research Verification Program.

County	Rice Type	Seed	Fertilizers & Nutrients	Herbicides	Insecticides	Fungicides & Other Inputs	Diesel Fuel	Irrigation Energy Costs
Clark	RT 7321 FP	204.44	177.88	221.18	---	15.00	19.65	5.39
Cross	RT 7321 FP	179.91	191.93	139.44	---	6.00	35.84	129.14
Drew	RT 7521 FP	192.98	137.72	164.98	---	---	16.07	136.42
Jefferson	DG 263 L	74.70	93.75	113.94	10.50	---	17.67	57.26
Mississippi	RT 7321 FP	179.91	192.68	126.61	---	6.46	13.11	49.88
Phillips	Titan	45.75	97.13	74.29	---	---	20.73	111.35
Pulaski	RT 7521 FP	163.29	152.53	122.86	---	33.74	17.60	24.08
White	RT 7321 FP	179.91	173.55	117.64	10.50	12.05	30.99	56.20
Woodruff	DG 263 L	91.30	165.76	92.77	---	---	27.68	106.26
Average	**---**	**145.80**	**153.66**	**130.41**	**10.50**	**14.65**	**22.15**	**75.11**