University of Arkansas System Division of Agriculture

Irrigation Yield Contest

MOST CROP PER DROP
Arkansas Irrigation Yield Contest

U of A
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Conducted by:

University of Arkansas Rice Research & Extension Water Management Team

Chris G. Henry, Ph.D. P.E. –Professor & Water Management Engineer

Russ Parker - Irrigation Program Associate

Robert Goodson - Irrigation Program Hourly

Rick Wimberley - Irrigation Program Hourly

Ranjitsinh Mane – Assistant Professor Agricultural and Consumer Economics

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Acknowledgments:

University of Arkansas County Extension Agents	
Extension Agents/Supervisors	**County**
Phil Horton	**Arkansas**
Grant Beckwith	**Arkansas**
Stewart Runsick	**Clay**
Amy Simpson	**Clark**
Kurt Beaty	**Chicot**
Jenna Martin	**Cross**
Katrina Owen	**Crittenden**
Gabe Pace	**Desha**
Scott Hayes	**Drew**
Dave Freeze	**Greene**
Matthew Davis	**Jackson**
Brady Harmon	**Jefferson**
Bryce Baldridge	**Lawrence**
Courtney Sisk	**Lawrence**
Stan Baker	**Lee**
Steven Stone	**Lincoln**
Kyle Sanders	**Lonoke**
Ethan Brown	**Mississippi**

Alan Beach	**Mississippi**
Craig Allen	**Poinsett**
Jeffrey Works	**Poinsett**
Shawn Payne	**Phillips**
Tucker Vonkanel	**Phillips**
Mike Andrews	**Randolph**
Jenna Martin	**St Francis**
Jerrod Haynes	**White**

All Grain Merchandisers & Personnel at Contestant Affiliated Elevators

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Executive Summary

The Arkansas Irrigation Yield Contest is a novel approach to promoting the adoption of Irrigation Water Management Practices. While there is a monetary prize for motivation, the peer comparison is believed to be a key feedback mechanism that drives improvement in irrigation acumen. The contest recognizes those that have achieved a highly developed skill to manage water resources. The impact of water management practice technologies are also quantified through this program. Many of the contest producers stated that adoption of the IWM tools such as moisture sensors and surge valves have a cost and time commitment in the first year to establish trust and acceptance, but in the end are beneficial at reducing labor and input costs.

In 2023, there were 46 producers from 23 counties throughout the Arkansas Delta and the Ouachita valley who entered 58 fields in the contest. Seven of the growers entered multiple crops and/or fields. The contest is an opportunity for farmers to explore their individual aptitude to reduce energy, water use, labor, and improve profitability. There are three categories available: Corn, Soybean, and Rice, with subcategories for Levee Rice, Furrow Rice, and for the first time, Zero Grade Rice. Each producer (except for flooded rice entries) used at least one irrigation management tool (e.g., computerized hole-selection; multiple-inlet rice irrigation; soil moisture sensors; surge irrigation).

In the soybean category, the average water use efficiency for 2023 was 3.49 bushels/inch WUE, versus 3.16 bushels/inch WUE in 2022. In 2021, the average was 3.53 bushels/inch WUE, while in 2020, the average was 3.48 bushels/inch WUE. 2019's average was 2.94 bushels/inch WUE, and 2018's was 2.86 bushels/inch WUE.

The corn category achieved average water use efficiency in 2023 of 9.98 bushels/inch WUE versus 7.19 bushels/inch WUE in 2022. In 2021, the average was 10.53 bushels/inch WUE, while in 2020, the average was 8.07 bushels/inch WUE. 2019's average was 8.06 bushels/inch WUE, and 2018's was 9.36 bushels/inch WUE.

In the rice category, the 2023 average was 5.90 bushels/inch WUE while the 2022 results were 5.44 bushels/inch WUE. 2021 through 2018 results were 5.46 bushels/inch WUE, 4.62 bushels/inch WUE, 4.70 bushels/inch WUE, and 5.17 bushels/inch WUE respectively.

Rules specific to the irrigation contest were developed and posted on a website along with the necessary entry and harvest forms. The contest was adapted from traditional yield contests

(Arkansas Soybean Association, 2014; National Corn Growers Association, 2015; National Wheat Foundation, 2018; University of California Cooperative Extension, 2018). Unlike traditional yield contests, the Arkansas Irrigation Contest winners are selected based on the highest Water Use Efficiency (WUE), where WUE is defined as the yield estimate divided by the total water received by the field. Total water includes rain plus irrigation. Rain was estimated from meteorological computer models, and irrigation water was measured with a portable propeller-style flow meter that was installed in a tamper-proof fashion. As in traditional yield contests, the yield estimate at harvest was supervised and witnessed by impartial observers (Extension and or NRCS workers). Of the categories, twelve winners were selected and awarded prizes totaling $128,552 value.

Clay County producer Mark Ahrent placed first in the corn division with a WUE of 13.49 bushels/inch. Lincoln County producer John Allen McGraw was second place with a WUE of 12.40 bushels/inch, while Jeremy Wiedeman of Clay County placed second with a WUE of 11.95 bushels/inch.

Cross County producer Karl Garner was awarded first place in the soybean division with a WUE of 5.05 bushels/inch. Lincoln County John Allen McGraw was second with a WUE of 4.80 bushels/inch. Frank Binkley of Lawrence County was third with a WUE of 4.14 bushels/inch.

Jackson County producer Stan Haigwood was awarded first place in the flooded rice division, with a WUE of 6.70 bushels/inch. Crittenden County producer Rieves Wallace placed second, achieving a WUE of 6.38 bushels/inch. Clay County producer Blake Ahrent placed third achieving a WUE of 6.36 bushels/inch.

Lincoln County producer John Allen McGraw was first in the furrow rice division. He achieved a WUE of 6.81 bushels/inch. Seth Tucker of Drew County was second with a WUE of 6.78 bushels/inch. Cross County producer Karl Garner third achieving a WUE of 5.28 bushels/inch.

First place in zero grade rice was Scott Whitaker of Desha County with a WUE of 8.23 bushels/inch. Second place is Chris Warren of Phillips County with a WUE of 7.24 bushels/inch, while Randolph County producer Billy Weitkamp placed third with a WUE of 7.20 bushels/inch

Awards were sponsored by Ricetec, the Arkansas Corn and Grain Sorghum Promotion Board, the Arkansas Soybean Promotion board, Seametrics, Delta Plastics, Irrometer, Trellis, FarmLogs, Agsense, and Crop X.

Each participant receives an individualized report card, providing feedback on their WUE and yield performance compared to the aggregated results from all the entries. The contest is strongly supported by the volunteer efforts and in-kind efforts of NRCS field offices and Extension agents who serve as supervisors for the contest. The irrigation industry and commodity boards also supported the contest through product and cash donations. ***The effort and support of these persons and organizations is greatly acknowledged and appreciated.***

Introduction

The overall objectives of the irrigation contest are,

- Educate producers on the benefits of using Irrigation Water Management Practices to improve profitability, sustainability, and reduce labor requirements for irrigation.
- Document the highest achievable Water Use Efficiency by crop type under irrigated row crop production in Arkansas.
- Reward and recognize producers who achieve a high level of irrigation water management acumen among their peers.
- Transfer knowledge of good irrigation water management practices from contestants to irrigation peers and to those that advise irrigators.
- Provide a platform for demonstrating Irrigation Water Management Practices at county and local levels.
- Provide a feedback mechanism for irrigators to benchmark their irrigation management skills.

Participation in the contest is entirely voluntary. Generally, the distribution of the contestants and contest winners are well distributed across the delta.

Materials and Methods

Rules were drafted in the spring of 2018 then refined each year. The contest rules are inspired by long-standing yield contests (Arkansas Soybean Association, 2014; National Corn Growers Association, 2015; National Wheat Foundation, 2018; University of California Cooperative Extension, 2018). Close attention was given to make the competition as unobtrusive to normal planting and harvest operations as possible while preserving the ability to produce accurate data and maintain a fair competition. In 2020 a change to how the growing season was determined was done for soybeans for more consistency. Harvest yield estimates are similar to or adapted from the California Rice Yield Contest, National Corn Growers Association Yield Contest, National Wheat Yield Contest, and the Arkansas "Go for the Green" Contest. Contestants harvest a minimum of three acres, harvested from the top of the field to the bottom, skipping two harvest machine widths between paths. A supervisor and a flowmeter are required to participate in the contest. UADA staff facilitate the contest, however a panel of impartial irrigation experts serve as judges to review methods and confirm the results.

Water Use Efficiency

Water use efficiency (WUE) is defined as the amount of yield produced per unit of water input. Irmak et al. (2011) defines Crop Water Use Efficiency as:

$$\mathbf{WUE_b = Y_i / (P_e + IR + \Delta\ SW)} \qquad \textit{Equation 1}$$

where WUE_b = benchmark water use efficiency, Y_i = yield of irrigated crop (bu/ac), P_e = effective rainfall (in), IR = Irrigation applied (in), and Δ SW = change in soil water content in the root zone during the growing season (in). For the irrigation contest, this same equation is used, without consideration of Δ SW. Given the high rainfall amounts experienced in Arkansas, the soil water content is relatively high during the first month of emergence, so it is assumed that contestants begin the season with a full or nearly full profile. Also, estimating this parameter adds unnecessary complexity to determining the results of the contest.

A challenge in determining WUE is the difficulty in estimating effective precipitation. Effective precipitation is defined as the amount of rainfall that is stored by the soil after the excess leaves the field as runoff. The precipitation events for each contestant were carefully evaluated for magnitude and impact on the results. There are dozens of published methods to estimate effective precipitation, however, they are all untested in this region. Rather than try to

select a method to estimate effective precipitation using a published method, effective rainfall is defined as less than 2 inches for thirty days after emergence and 3 inches for the remainder of the season until maturity. Rainfall events over 2 inches in depth are reduced to 2 inches for the first 30 days after emergence. After 30 days from emergence, any rain events that exceed 3 inches are reduced to 3 inches. Most furrow irrigation events are nearly 3 inches; this is the reasoning behind using 3 inches as an effective rainfall depth. With this adjustment, in 2018, 2019 and 2020 there were only a few extreme events and the adjustment did not have any impact on the results. In 2021, a significant rain event occurred south of Interstate 40 over a 6-day period from June 5 through June 10. Total rainfall ranged from 11.9 inches to 6.4 inches, and the adjustments were minimal. This affected approximately 5 growers. No adjustments have been needed in 2022 and 2023.

Equation 2 was used to calculate the water use efficiency for each contestant. It is defined as the harvest yield estimate divided by the total water delivered to the field,

$$\mathbf{WUE = Y / (P_e + IRR)} \qquad \textit{Equation 2}$$

where WUE = Water Use Efficiency in bushels per inch, Y = Yield estimate from harvest in bushels per acre, P_e = Effective precipitation in inches, and IRR = Irrigation application in ac-inches/ac.

Meter Sealing

Irrigation amounts were totalized using 6 inch, 8 inch, 10 inch, and 12 inch portable propeller meters manufactured by McCrometer. Each meter was sealed using the following process.

Figure 1. Example of Universal Hydrant Sealing

- Meters were sealed to the universal hydrant by using circle lock clamps or horseshoe clamps
- Serialized cable ties are used to secure the clamps and fittings. These cables can only be removed by cutting the cable.
- The fitting connections are wrapped with poly pipe tape.

- A unique identifying stamp is used across the tape.

Universal hydrants are secured to the alfalfa valve and from the alfalfa valve to the meter using the same procedure. Any additional fittings, if needed, are also secured using this procedure to ensure that no other irrigation water source can contribute to the field. Figure 1 shows a typical meter sealing configuration. All other possible sources of irrigation water to that field were sealed to prevent non-measured irrigation sources from being used in the contest field (Figure 2).

Figure 2. Example of an alfalfa valve sealing done to exclude other sources.

Only mechanical propeller meters are used in the contest. For the winning entries, all meters are checked against a reference meter and must test within 5% of the reference meter, or else the water use is adjusted according to the reference meter and the contest results adjusted accordingly.

Assigning Days to Measure Rainfall

Part of the rainfall measurement is the decision concerning exactly which days to measure rainfall for each field. The intent is to measure rainfall from emergence to physiological maturity. For every crop field entered in the contest the planting date is the basis for emergence date which is recorded on every entry form. Seven days after the planting date is the assumed emergence date and rainfall contributions are accumulated from then until maturity. Corn is the most straightforward crop to assign the date of physiological maturity. Seed companies publish their maturity information in sales literature. Published days to maturity are used to determine the time after emergence. Emergence is assumed as 7 days after planting. This defines the period for which rainfall contributions are accumulated.

For rice, the University of Arkansas Division of Agriculture DD50 models are used (Hardke, 2020). Such models can be used to plan fertilizer, pesticide, and scouting decisions. The UA DD50 program (dd50.uaex.edu) requires the variety, location, and emergence date, then

returns dates of growth stage management events. The predicted drain date for the planted variety for each contestant is used as the last day to measure rainfall on that contest field. Emergence date is assumed as 7 days after planting. The rainfall between these periods is accumulated for the precipitation contribution for each contestant field.

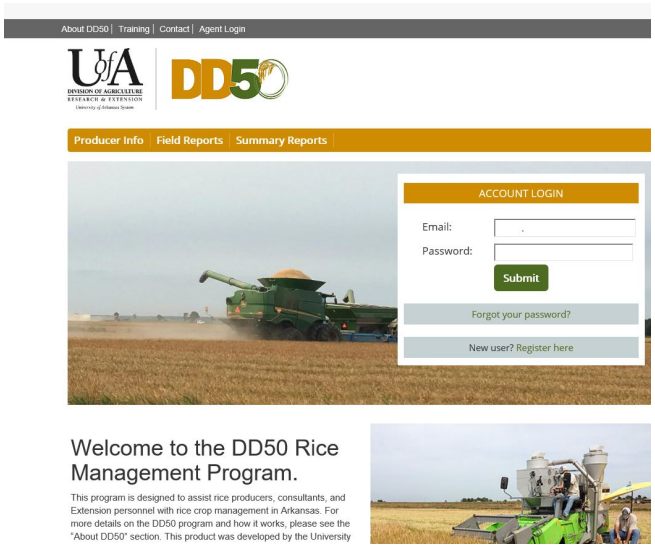


Figure 3. University of Arkansas DD50 Rice Website

For soybeans, the previous method was to use commercially available published data, but in 2020 the following procedure was adopted. A similar process is used to establish the emergence data, 7 days after the planting date reported. The end of rainfall accumulation is assumed to be at R 6.5. This is chosen so that late season rainfalls do not penalize contestants, as it is assumed that R 6.5 would be the latest that rainfall accumulations would affect yield. Next the University of Arkansas soybean crop model SoyStage (http://soystage.uark.edu) is used to model the growth stages. SoyStage (*Figure 4*)was developed using Arkansas research trials (dos Santos et al., 2014; Salmeron et al., 2015; Salmeron et al., 2016; Weeks et al., 2016; Salmeron et al., 2016; Salmeron et al., 2017). The SoyStage model provides R5 and R7 but not R6.5. To determine R6.5 the Mississippi State University Extension, Maturity Date Calculator – SoyPheno (https://webapps.msucares.com/deltasoy/) is used to determine R6 for the maturity group and planting date reported by the contest grower (Mississippi State University, 2020). Then the difference in the dates from R7 from SoyStage and R6 from SoyPheno are used to determine the R6.5 date. Rainfall is accumulated from the assumed emergence date until this estimated R6.5 date.

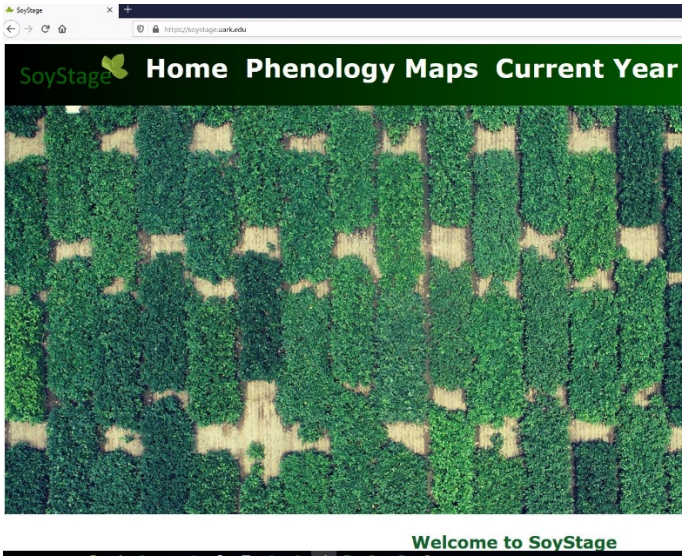


Figure 4. SoyStage website

Rainfall Estimation

Farmlogs™ (Ann Arbor, MI) was used exclusively for 2021. Comparisons between Farmlogs™ and Climate Corporations Fieldview™ (San Francisco, CA) were done in 2020, with similar results. Both programs are computer-based services that provide rainfall estimates for user defined areas, using mobile apps or internet browsers. For the contest, rainfall amounts for each contest site using the data provided on entry forms was used to track rainfall contributions to the fields. The rainfall values were added with total applied irrigation to get the total water use. **Error! Reference source not found.** shows the total rain during the growing seasons the contest has been conducted. The precipitation was assessed for each contest site utilizing the commercial rain prediction service, Farmlogs™. This service uses a computer algorithm to determine rain intensity derived from National Weather Service products. This approach is used instead of rain gages so that tampering of rainfall data is not possible. The rainfall generated data may not be completely accurate against a well-maintained weather station, but it is assumed to be equally unbiased across all contest sites. Between 2018 and 2019 a more detailed analysis comparing actual rainfall from 18 weather stations with the modeled data was conducted and found not significant difference (P=0.95) using this approach results in a good estimate of rainfall compared to a weather station during the growing season. Details of this analysis are discussed in the 2020 contest report. The annual rainfall for each year of the contest is shown in Figure 5

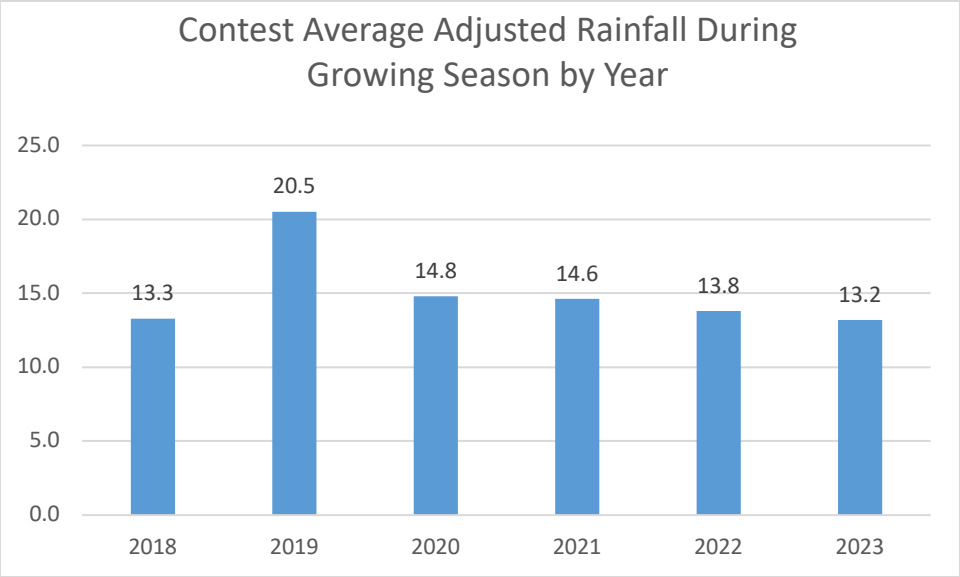


Figure 5. Contest Average Adjusted Rainfall During Growing Season by Year

Table 1. Rainfall Data for 2023 Contest Fields

Location	Crop	Irrigation Type	Variety	Planting Date	Maturity Date	Rainfall Inches (Unadj)	Rainfall Inches (Adj)
Clay	Corn	Furrow	Pioneer 1718	4/1/23	7/27/23	10.77	10.77
Lincoln	Corn	Furrow	DK 65-99	3/29/23	7/22/23	13.67	13.67
Clay	Corn	Furrow	Pioneer 1718	4/10/23	8/5/23	10.87	10.87
Greene	Corn	Furrow	DK 65-99	4/11/23	8/4/23	12.15	12.15
Mississippi	Corn	Furrow	Revere 1307	4/8/23	7/30/23	14.40	14.40
Chicot	Corn	Furrow	DK 67-44	3/24/23	7/19/23	19.62	19.62
Poinsett	Corn	Furrow	Pioneer 1847	3/29/23	7/25/23	13.44	13.26
Mississippi	Corn	Furrow	DK 67-44	4/12/23	8/7/23	16.56	16.56
Randolph	Corn	Furrow	DK 65-99	4/8/23	8/1/23	11.18	11.18
Mississippi	Corn	Furrow	DK 65-99	4/10/23	8/3/23	15.93	15.69
St Francis	Corn	Furrow	DK 65-99	4/11/23	8/4/23	13.17	13.13
Phillips	Corn	Furrow	DK 65-99	4/1/23	7/25/23	15.95	15.95
Lincoln	Rice	Furrow	FP7321	4/15/23	7/27/23	8.40	8.40

Drew	Rice	Furrow	FP7521	4/1/23	7/27/23	12.5	11.9
Cross	Rice	Furrow	FP7521	4/19/23	7/27/23	11.9	11.9
Crittenden	Rice	Furrow	FP7521	4/4/23	8/23/22	10.4	10.4
Lawrence	Rice	Furrow	RT 753	4/25/23	8/18/22	12.9	12.9
Mississippi	Rice	Furrow	RT 7521	4/17/23	8/6/23	14.55	14.26
Jackson	Rice	Levee	RT 7521	5/10/23	8/31/23	12.85	12.14
Crittenden	Rice	Levee	RT 7321	4/15/23	8/8/23	12.86	12.86
Clay	Rice	Levee	RT 7521	4/4/23	8/11/23	13.11	13.11
Jefferson	Rice	Levee	DG263L	3/29/23	7/29/23	15.19	14.34
Poinsett	Rice	Levee	DG263	4/3/23	8/5/23	13.66	13.52
Desha	Rice	Zero	RT 7508	4/15/23	8/14/23	16.64	16.64
Randolph	Rice	Zero	CLM04	4/17/23	8/26/23	13.42	13.42
Phillips	Rice	Zero	RT 753	5/10/23	8/21/23	7.40	7.40
Desha	Rice	Zero	RT 7321	4/20/23	8/12/23	14.66	14.66
Desha	Rice	Zero	RT 753	4/15/23	8/7/23	19.03	18.9
White	Rice	Levee	RT 7302	5/19/23	9/4/23	18.00	18.00
Crittenden	Rice	Furrow	RT 7321	4/11/23	8/9/23	16.50	16.50
Lonoke	Rice	Furrow	RT 7421	5/4/23	8/25/23	9.40	9.40
Cross	Soybean	Furrow	Asgrow 46XF3	5/3/23	8/19/23	12.1	12.1
Lincoln	Soybean	Furrow	Pioneer 43A42X	4/14/23	7/30/23	10.71	10.71
Lawrence	Soybean	Furrow	Asgrow 48XF3	4/11/23	7/21/23	10.36	10.36
Crittenden	Soybean	Furrow	Dyna Grow 47Xf23s	5/26/23	9/2/23	9.59	9.59
Phillips	Soybean	Furrow	Pioneer 45A20LX	5/5/23	8/18/23	8.66	8.66
Poinsett	Soybean	Furrow	Pioneer 48A6DX	4/3/23	8/5/23	16.9	16.9
Crittenden	Soybean	Furrow	Asgrow 42XFO	4/15/23	8/7/23	9.69	9.69
Arkansas	Soybean	Furrow	Asgrow 48X9	5/20/23	8/29/23	8.40	8.40
Poinsett	Soybean	Furrow	NK 44jhxf	5/2/23	8/27/23	12.16	11.97
White	Soybean	Furrow	Becks 4777xf	4/12/23	8/6/23	13.84	13.84
Mississippi	Soybean	Furrow	Progeny 4505	5/1/23	8/16/23	18.47	17.08
Prairie	Soybean	Furrow	GoSoy 481E19	5/23/23	8/31/23	8.07	8.07
Mississippi	Soybean	Furrow	Becks 4991	4/12/23	8/8/23	17.06	17.06
Clay	Soybean	Furrow	Pioneer 47A64X	5/1/23	8/21/23	10.58	10.58
Mississippi	Soybean	Furrow	Becks 4885XF	4/4/23	8/4/23	16.35	16.35

Lee	Soybean	Furrow	Pioneer 46A20	4/3/23	8/2/23	12.10	11.35
Randolph	Soybean	Furrow	NK47XF	5/3/23	8/21/23	11.41	11.41
Mississippi	Soybean	Furrow	Becks 5005	5/15/23	8/31/23	13.17	13.17
Monroe	Soybean	Furrow	Gateway 467	4/12/23	8/3/23	12.18	11.61

Harvest Yield Estimate

The yield estimate for the contest is determined by harvesting a three-acre sample of the contest field. Every contest field harvest was witnessed or supervised by a third party. Supervisors must not have a financial interest in the contest field. In most cases extension agents and or NRCS personnel are contest supervisors.

Supervisors are encouraged to help with the decision making of irrigation decisions and can be involved during the season. Harvest operations were witnessed by supervisors or University of Arkansas Division of Agriculture (UADA) staff designated on the entry form. Before harvest, the combine grain hopper, grain cart, and truck hoppers are inspected and confirmed to be empty. A minimum of three acres was harvested and weighed using a certified scale. The supervisor witnesses the full and tare weighing of the harvest truck.

Yields are adjusted to 12.0% moisture for rice, 13.0% for soybeans and 15.5% for corn. Foreign matter % is deducted from the yield for corn and soybeans. Harvested area must be measured and certified by a supervisor. The contest harvest area was generally determined by measuring row lengths and width of cut, regardless of the crop. Measurements were taken using a digital rangefinder. Passes must be from the top to the bottom of the field with as many passes as necessary from the top and bottom to facilitate harvest of at least 3 acres.

In 2019, a minimum yield requirement was added to account for deficit irrigation and reasonable commercially acceptable yields. It is well known by irrigation scientists that high Water Use Efficiency (WUE) can be achieved through deficit irrigation. For 2021, minimum yield was set at 200 BPA for corn, 180 BPA for rice and 60 BPA for soybean. Those minimum yields were continued for 2023. Thus, the contestants must achieve a commercially acceptable yield and a high WUE to win. As the contest develops the judge panel can use past results to further justify a fair minimum yield.

2023 Contest Participants & Field Requirements

The 2023 Arkansas Irrigation Yield Contest was conducted on 58 commercial fields that were 30 acres or larger from across the Arkansas Delta and Quachita Valley. 23 counties participated in the program: Arkansas, Clay, Chicot, Clark, Cross, Crittenden, Desha, Drew, Greene, Jackson, Jefferson, Lawrence, Lee, Lincoln, Lonoke, Monroe, Mississippi, Phillips, Poinsett, Randolph, St Francis, Woodruff, and White counties totaling 2871 acres. The field must have only one irrigation water source or riser to the field (multiple pumps may supply the field through a single hydrant). Entries are for zero grade rice, levee rice, furrow rice, soybeans, and corn. A contestant may enter the competition with more than one crop but may not win for more than one crop per year. First-place winners may never win or enter the same crop again, but are allowed to enter other crops in subsequent years. Unlike other yield contests that have multiple categories and production systems represented, the irrigation contest is limited: This limitation is meant to recognize as many irrigators as possible given the limited resources available. Contestants must be 18 years old at the time of entry, and promotion board members (and their spouses) who support the contest are not allowed to enter in the respective commodity category contest.

Description of Awards

Participants were awarded for highest water use efficiency in each crop category (Corn, Soybean, Flooded Rice and Furrow Rice) is given to each of the Twelve winners that contain various cash prizes and or products from the sponsors who generously contributed to the contest. Table 2 highlights the prizes for the winners. In total over $128,552 in cash and products are distributed to the winners of the contest.

Table 2. Prizes Awarded

Rice Division 1 each Flood, Furrow, and Zero Grade	Corn Division	Soybean Division
$12,000 seed tote credit sponsored by RiceTec	**$6,000** cash sponsored by the Arkansas Corn and Grain Sorghum Promotion Board	**$6,000** cash sponsored by the Arkansas Soybean Promotion Board
$7,260 of RiceTec seed	**$3,000** cash sponsored by the Arkansas Corn and Grain Sorghum Promotion Board	**$3,000** cash sponsored by the Arkansas Soybean Promotion Board
$3,740 of RiceTec seed	**$1,000** cash sponsored by the Arkansas Corn and Grain Sorghum Promotion Board	**$1,000** cash sponsored by the Arkansas Soybean Promotion Board
$2,000 in cash from Delta Plastics		

For First Place Winners of the Corn, Rice (overall) and Soybean Division Prizes	
	Irrometer Telemetry reader and three watermark sensors $825 in product retail value $2,475 in total

	Trellis Base and Sensor Station $1,000 in product retail value $3,000 in total
	10” Seametrics AG 90 Insertion Magmeter (Flowmeter) $1,507 in product retail value $4,521 in total
	Aquatrac AgSense Soil Moisture Monitoring Unit $1,200 retail value $3,600 in total
	CropX Soil Moisture Monitoring Unit $1,500 retail value $4,500 in total

FarmLogs POWERED BY BUSHEL	One Year Subscription to Farm Logs $228 retail value $684 in total

Irrigation Water Management Tools

Contestants were asked about the Irrigation Water Management (IWM) tools they would utilize on the contest field when they enter the contest. All but two of the contestants used Computerized Hole Selection (Pipe Planner or PHAUCET or the Rice Irrigation app) during the 2020 growing season in their contest fields. Table 3 shows mixed use of sensors in the contest field. However, it is common, when sensors are used, to see them be used for decision making in several adjacent fields. Considering this, it is possible sensors are being used by contestants at a rate higher than these numbers indicate. The data from entry forms is incomplete, but shows positive change in computerized hole selection use. Furrow Irrigated Rice (FIR) continues to be a popular practice to use and increased from previous years.

Table 3. Percentages of Contestants Using Irrigation Technologies in Contest Field (%)

	Soil Moisture Sensors	*Pipe Planner*	*Furrow Irrigated Rice*	*Surge Valves*
2023	85	100	54	22
2022	81	79	64	12
2021	87	97	80	35
2020	42	100	73	16
2019	40	43	38	28
2018	50	73	50	44

Contest 6 Year Data

The Arkansas Irrigation Yield Contest's primary goal is to encourage the use of irrigation water management tools by farmers. As an added benefit, data from 149 fields have been recorded across the delta region. Most importantly the WUE of each field was determined. Though WUE data from production fields can be found intermittently from various sources such as the Arkansas verification fields, a large data set of WUE from a number of locations across multiple years is not readily available. The data set from the competition, in addition to WUE, also provides the yield, applied irrigation, adjusted rainfall, and total water applied.

An effort was made to compare data from the six years the contest was conducted, but it is difficult to infer trends in WUE over the years due to the variation among contestants' results, although a general trend of increasing WUE is emerging. Also in corn and soybeans the max WUE is increasing suggesting that irrigators over time are increasing their WUE's and thus the contest difficulty (to win) is increasing over time. A wide range of management styles and field conditions are represented. Figure 6 shows the distribution of WUE over the six years.

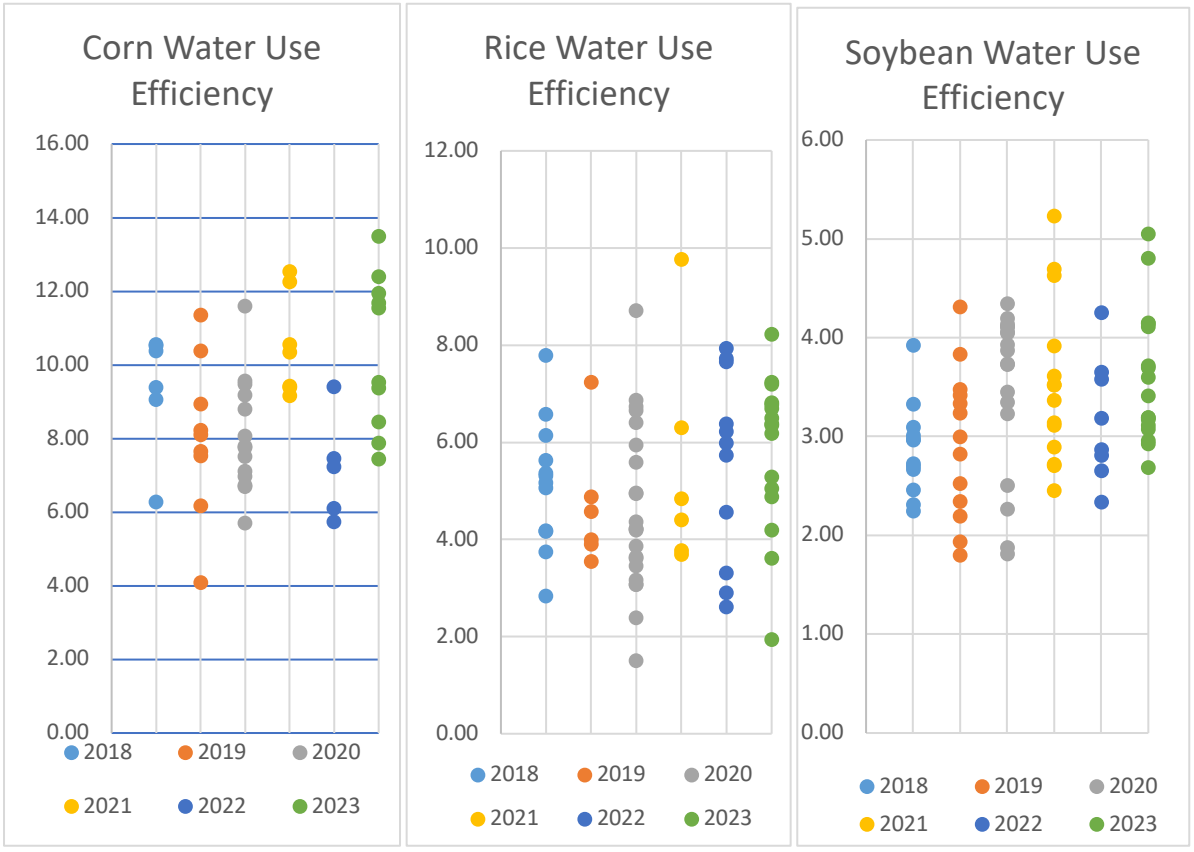


Figure 6. 6 Year Scatterplot for Rice, Corn, and Soybean Water Use Efficiency

Error! Reference source not found. The data was then combined from all six years for each crop. This data can be seen in **Error! Reference source not found.** for soybeans, **Error! Reference source not found.** rice, and Table 7 corn. The average WUE over the 6-year period for soybean was 3.29 Bu/In, the average for corn was 8.89 Bu/In, and the average for rice was 5.22 Bu/In.

In the WUE calculation, the amount of rainfall that the field receives can be a large component in the total water. More rain does not always translate to less irrigation water needed, but WUE is determined by both rain and irrigation water. By plotting rainfall against WUE using all six years, linear regression and goodness of fit was determined. Across all three crop types, no linear relationship was found between rainfall and WUE Figure 7. Adjusted rainfall is used in this calculation as it was used to determine the WUE. However, fewer than ten of the 149 data points have an adjusted rainfall value that differs from the recorded rainfall. Thus, the amount of rainfall received is not considered a factor in the WUE results.

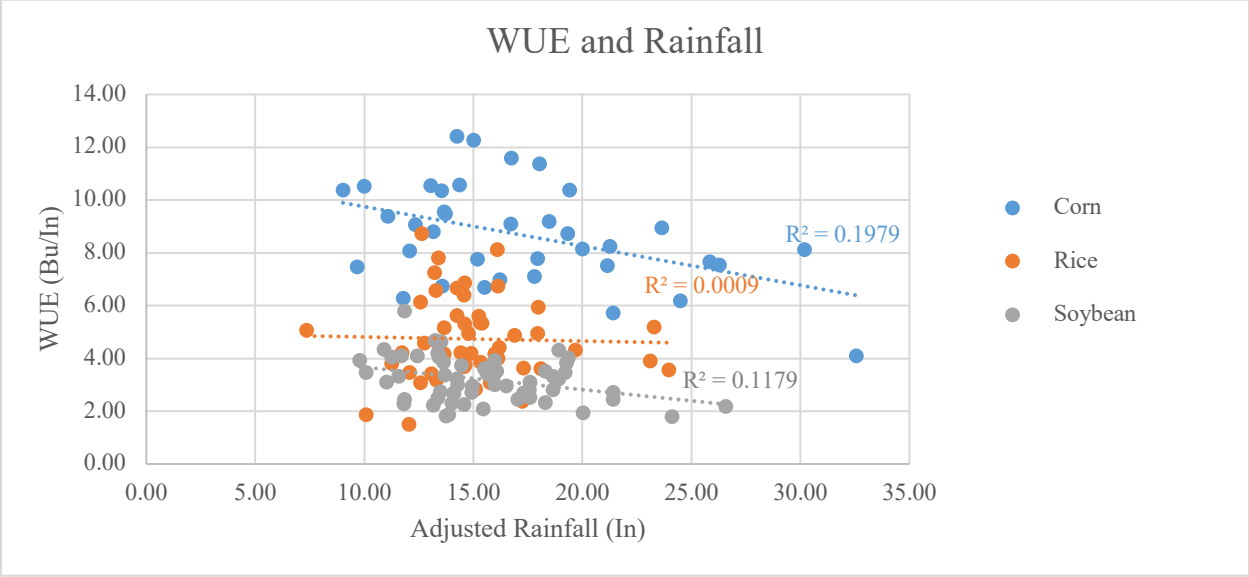


Figure 7. WUE vs. Rainfall for All Years and Crops

By plotting the yield against the WUE, linear regression was performed to determine the goodness of fit between WUE and yield as shown in Figure 8. Across all three crop types there is no significant relationship between yield and WUE. While it may appear that there is relationship between lower yields and lower WUE, in most instances the fields that are on the lower ends were irrigated as if they would yield higher but may have had confounding issues. This causes a normal amount of water to be used with a below normal yield resulting in a lower WUE. Thus, it is believed that the yield obtained is not a significant factor in the WUE for a contest entry.

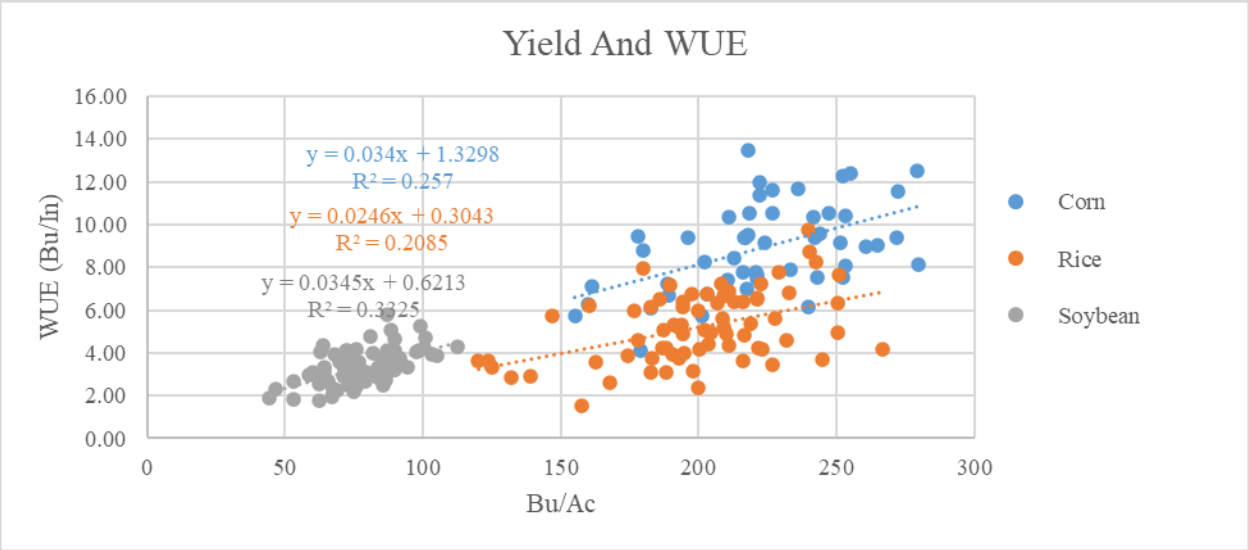


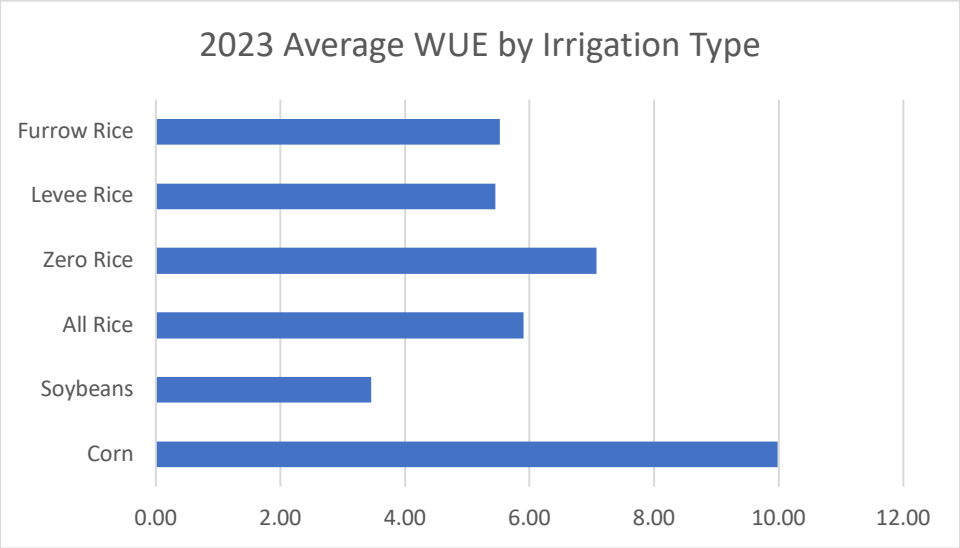
Figure 8. Yield vs. WUE for Six Years and All Crops

Contest Results

Results were calculated for each contestant. First the effective precipitation was determined, and meter readings were calculated and verified. The yield estimates were then taken from the verified harvest forms and the WUE was determined. Contestants were ranked from high to low. The winning meters were checked against a reference meter to confirm accuracy within five percent. The contest results were presented to a panel of three judges, who are experts in the field of irrigation, to review the technical methods used to determine the rankings. The judge panel reviewed the rankings and confirmed the results.

The following chart reports the average Water Use Efficiency for each crop category in the contest for comparison to the winners WUE. Water use efficiency is reported in bushels of grain per volume of irrigation water and precipitation depth. Soybeans averaged 3.46 bushels per inch, the rice category averaged 5.90 bushels per inch, and corn averaged 9.98 bushels per inch.

Reference to the irrigation water use and yields in Arkansas Verification Programs is only done for reference to other measured water use and yield estimates for commodity crops and should only be interpreted as an average water use one may expect from these crops under average recent history conditions.



Corn Contest Results

Overall, 13 corn fields were entered into the contest. The average yield of corn grown for the contest was 226.16 BPA and the average water use efficiency of corn grown for the contest was 9.98 bushels/inch (Table 4). The 2023 winner achieved the highest Water Use Efficiency to date in the contest. The average yield was 24.95% higher than the state average for 2018 of 181 BPA (USDA National Agricultural Statistics Service, 2018). Corn yield was corrected to 15.5% moisture for every field. The highest yielding corn fields were in Mississippi and Poinsett Counties with a yield of 272.00 and 271.60 BPA. The water use efficiency ranged from a high of 13.49 bushels/inch to a low of 7.44 bushels/inch. The average irrigation water added to corn contest fields was 9.38 inches. The highest irrigation water added to a corn contest field was

18.37 inches and the lowest irrigation water added was with 3.24 inches of irrigation. One field was withdrawn from the contest prior to harvest. Two fields did not meet the minimum yield of 200 BPA.

Table 4. Corn Yield and Water Use Efficiency

Grower	Variety	Yield (Bushels / acre)	Irrigation (Acre inches / acre)	Rain (inches) (Unadjusted)	Rain (inches) (Adjusted)	Total Water Use (Inches)	Water Use Efficiency bushels per Inch
Mark Ahrent	Pioneer 1718	217.73	5.37	10.77	10.77	16.14	13.49
John Allen McGraw	DK 65-99	255.16	6.90	13.67	13.67	20.57	12.40
Jeremy Wiedeman	Pioneer 1718	222.00	7.71	10.87	10.87	18.58	11.95
Contestant 4	DK 65-99	236.00	8.05	12.15	12.15	20.20	11.68
Contestant 5	Revere 1307	272.00	9.16	14.40	14.40	23.56	11.54
Contestant 6	DK 67-44	218.00	3.24	19.62	19.62	22.86	9.54
Contestant 7	Pioneer 1847	271.60	15.69	13.44	13.26	28.95	9.38
Contestant 8	DK 67-44	213.00	8.66	16.56	16.56	25.22	8.45
Contestant 9	DK 65-99	233.00	18.37	11.18	11.18	29.55	7.88
Contestant 10	DK 65-99	221.00	14.00	15.93	15.69	29.69	7.44
Contestant 11	DK 65-99	189.22*	11.26	13.17	13.13	24.39	7.76*
Contestant 12	DK 65-99	165.22*	4.18	15.95	15.95	20.13	8.21*

*Did not meet the minimum yield of 200 bushels per acre

Rice Contest Results

The Rice Irrigation Contest produced a broad range of results in terms of water use between the twenty-four fields entered (6 Zero Grade, 9 furrow, and 9 levee. In 2023, furrow irrigated rice was used in nine contest fields with an average yield of 197.43 BPA and an average WUE of 5.52 bushels/inch. Flood irrigation was used on six fields. The average yield was 218.4

BPA and average WUE was 5.45 bushels/inch. Zero grade irrigation was used on six fields. The average yield was 198.97 and the average WUE was 7.07 bushels/inch. Tabular results from the rice contest are shown in Table 5**.** Two entries did not meet the minimum yield in Row Rice, and one entry withdrew prior to harvest. One entry in the levee rice category did not meet the minimum yield, and three entries withdrew prior to harvest. One entry in the zero-grade category withdrew prior to harvest. Six fields were planted with RT FP 7521, three fields were planted with RT 7321 FP, two fields were planted with RT 753, two fields were planted with DG 263, and there was one field of CLM04.

The average rice yield in the contest was 212.11 BPA and the average rice water use efficiency was 5.83 bushels/inch Table 5. The yield average for the rice contest was 26.94% higher than the state average rice yield of 167 BPA for 2018 (USDA National Agriculture Statistics Service, 2019).

Table 5. 2023 Rice Yield and Water Use Efficiency

Grower	Cultivar	Yield (Bushels / Acre)	Irrigation (acre inches / acre)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels / Inch)
Levee							
Stan Haigwood	RT7521	209	18.4	12.9	12.9	31.2	6.70
Rieves Wallace	RTFP7321	216	21.0	12.9	12.9	33.8	6.38
Blake Ahrent	RT7521	250	26.2	13.1	13.1	39.3	6.36
Contestant 4	DG263L	179	15.4	18.0	18.0	33.4	5.35
Contestant 5	DG263	200	32.6	15.2	15.2	47.8	4.19
Contestant 6	RT7302	216	46.2	13.7	13.7	59.8	3.61
Furrow							
John McGraw	RT7321	233	22.6	11.6	11.6	34.2	6.81
Seth Tucker	RT7521	198	14.4	14.8	14.8	29.1	6.78
Karl Garner	RT7521	194	23.0	13.7	13.7	36.6	5.28
Contestant 9	RT7521	187	21.5	15.6	15.6	37.0	5.05
Contestant 10	RT753	194	27.7	12.1	12.1	39.8	4.88
Contestant 11	RT7521	238	108.1	14.6	14.6	122.6	1.94
Contestant 8	RT7321	171*	15.1	16.5	16.5	31.6	5.39*
Contestant 7	RT7521	165*	11.3	9.4	9.4	20.7	8.00*
Zero Grade							
Scott Whitaker	RT7801	243	12.8	16.6	16.6	29.5	8.23
Chris Warren	RT753	223	23.3	7.4	7.4	30.7	7.24

Billy Weitkamp	CLM04	190	12.9	13.4	13.4	26.4	7.20
Contestant 12	RT7321	221	19.4	14.7	14.7	34.0	6.50
Contestant 13	RT753	183	10.5	19.0	19.0	29.5	6.18
Contestant 14	RT753	135*	5.4	12.3	12.3	17.7	7.06*

*Did not meet minimum yield of 180 bushels per acre

The average yield for all rice fields was corrected to 12% moisture. Yields in the rice contest ranged from a high of 250 BPA (flooded rice) to a low of 135 BPA (zero grade rice). The average irrigation water added for all contest rice fields was 24.38 inches. The highest irrigation water applied to a contest rice field was 108.1 inches and the lowest amount of irrigation water added to a contest rice field was 5.4 inches (Table 5). The average WUE was 5.96 Bu/in.

Soybean Contest Results

Twenty-one fields were entered in the soybean division. The average yield for all soybean contest fields was 76.53 BPA (30.88% above the state average yield of 52.9 BPA) (USDA National Agricultural Statistics Service, 2017). The winning soybean entry achieved the second highest Water use efficiency to date in the contest. The soybean contest average water use efficiency was 3.46 bushels/inch (Table 6). All contest fields were corrected to a 13.5% moisture for the soybean yields considering harvest conditions.

Table 6. Soybeans Yield and Water Use Efficiency

Grower	Variety Selection	Yield (Bushels/Acre)	Irrigation (ac-in/ac)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels/ Inch)
Karl Garner	Asgrow 46XF3	88.42	5.43	12.1	12.1	17.5	5.05
John Allen McGraw	Pioneer 43A42X	80.72	6.11	10.71	10.71	16.8	4.80
Frank Binkley	Asgrow 48XF3	89.50	11.26	10.36	13.36	21.6	4.14
Contestant 4	DynaGro 47XF23s	72.75	8.13	9.59	9.59	17.7	4.11
Contestant 5	Pioneer 45A20LX	81.7	11.71	8.66	8.66	20.4	4.01
Contestant 6	Pioneer 48A6DX	88.84	7.04	16.9	16.9	23.9	3.71
Contestant 6	Asgrow 42XFO	73.50	10.22	9.69	9.69	19.9	3.69

Contestant 7	Asgrow 48X9	69.79	11.02	8.40	8.4	19.4	3.60
Contestant 8	NK 44JHXF	85.80	13.23	12.16	11.97	25.2	3.41
Contestant 9	Becks 4777XF	89.56	14.24	13.84	13.84	28.1	3.19
Contestant 10	Progeny 4505	72.61	5.70	18.47	17.08	22.8	3.19
Contestant 11	GoSoy 481E19	71.44	14.47	8.07	8.07	22.5	3.17
Contestant 12	Becks 4991	79.61	8.52	17.06	17.06	25.6	3.11
Contestant 13	Pioneer 47A64X	86.67	18.76	10.58	10.58	29.3	2.95
Contestant 14	Becks 4885XF	71.14	7.98	16.35	16.35	24.3	2.93
Contestant 15	Pioneer 46A20	79.26	18.21	12.1	11.35	29.6	2.68
Contestant 16	NK 47XF	60.03	8.15	11.41	11.41	19.6	3.07
Contestant 17	Becks 5005	59.11*	6.30	13.17	13.17	19.5	3.04
Contestant 18	Gateway 467	53.70*	15.90	12.18	11.61	27.52	1.94

*Did not meet minimum yield of 60 bushels per acre

The average irrigation water added to a contest soybean field was 10.65 acre-inches per acre added. Table 6 compared to the irrigator reported state average soybean water use of 16.3 acre-inches (Arkansas Water Plan, 2014). The highest irrigation water use by a contested soybean field was 18.76 inches. The lowest irrigation water applied to a contested field was 5.43 inches to the 1st place soybean contest field. Two contestants dropped out of the contest prior to harvest, and two contestants did not meet the minimum yield. The maximum yield in the contest was 89.56 bushels/acre while the contest average was 76.53 BPA Table 6.

Social Media

The contest is promoted primarily on Twitter through the personal accounts of Dr. Chris Henry (@cghenry_ua,) with 594 followers, Robert Goodson (@goodsonretired) with 791 followers, Rick Wimberley (@rick_wimberley) 153 followers, and Russ Parker (@russparker11) with 413 followers. There was a contest twitter account established in 2023, Arkansas Crop Per Drop Contest (@CropPerDropAr) with 16 followers. Total direct followers 1,467 are exposed to the Contest.

Conclusions

The Arkansas Irrigation Yield Contest is a novel approach to promoting the adoption of Irrigation Water Management Practices. While there is a monetary prize for motivation, the feedback mechanism that provides data to each contestant on how they compare to their peers provides each participant with a benchmark to improve water management skills and to recognize those that have achieved a highly developed skill to manage water resources. The impact and synergisms of utilizing the many water management practice technologies that are available are also quantified through this program. The 2023 Irrigation Yield Contest results created many success stories. There is a group of contestants who are multi-year participants, with several in the group having won in multiple crop categories. Many of these multi-year contestants continue to improve their water use efficiency year over year, and become comfortable with increasing allowable depletions and comfort with technology. Our observation is that the adoption of moisture sensors, along with use of the UA moisture sensor app in the case of watermark sensors, we witness more irrigators using these tools to make informed decisions. Another long-term observation has been that management is a large factor in those that perform well in the contest, and that the IWM tools and technologies are aids that help improve their ability to manage irrigation more effectively.

First time Surge Valve user Billy Weitkamp stated that his Randolph County soybean field had never watered out as well as it did in 2023. Additionally, he was pleased to report that his contest corn field monitored with moisture sensors, telemetry, and interpreted with the UA soil sensor calculator mobile app, resulted in two fewer irrigations compared to his other corn fields, as well as his operations highest corn yield to date.

First year Contestants Kevin and Billy Weitkamp with their Surge Valve.

Previous winner Brandon Cain installing the Aquatrac he won in 2021 with his corn entry. Brandon is assisted by White County Extension agent Jerrod Haynes.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