University of Arkansas System Division of Agriculture
Irrigation Yield Contest

MOST CROP PER DROP
Arkansas Irrigation Yield Contest

UofA
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

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All Grain Merchandisers & Personnel at Contestant Affiliated Elevators

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Executive Summary

The University of Arkansas System Division of Agriculture Irrigation Yield Contest, sometimes called “Most Crop per Drop”, is a research and Extension program that promotes the adoption of irrigation water management practices. There was a marked increase in participation from 2019 to 2020. There were 46 producers (43% increase) from 20 counties (25% increase) throughout the Arkansas Delta region who entered 57 fields (78% increase) in the contest. Ten of the growers entered multiple crops and/or fields in 2020 compared to 2019 when no contestants entered multiple fields or crops. 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. Each producer used at least one irrigation management tool (computerized hole-selection, multiple inlet rice irrigation, soil moisture sensors or surge irrigation). For the 2020 season, a higher water use efficiency was obtained by a grower in two of the three categories than the highest water use efficiency obtained in the previous two seasons. In the soybean category, 7 contestants achieved more than 4 bushels/inch WUE, in 2019 only 1 contestant did, and in 2018 there were none. This is a clear indication in the ability of irrigators to improve their water use efficiency.

Rules specific to an irrigation contest were developed and a website was created to host information as well as 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 three categories, nine winners were selected and awarded prizes totaling $62,809.

Jefferson County producer Chad Render was first in the corn division with a yield of 225 bushels/acre and WUE of 11.5 bushels/inch. Greene County producers Terry and Clay Smith were second in the corn division with a yield of 242 bushels/acre and a WUE of 9.5 bushels/inch. White County producer Brandon Cain was third in the corn division with a yield of 250 bushels/acre and a WUE of 9.25 bushels/inch.

Clay County producer Jeremy Wiedeman was first in the soybean division with a yield of 64 bushels/acre and a WUE of 4.37 bushels/inch. Lincoln County producer John Allen Mcgraw was second for the soybean division with a yield of 76 bushels/acre and a WUE of 4.25 bushels/inch. Mississippi County producers Sullivan Family Ag (Mike Sullivan) was third in the soybean division with a yield of 99 bushels/acre and a WUE of 4.15 bushels/inch.

Mississippi County producer Cody Fincher was first in the rice division. He achieved a yield of 240 bushels/acre and a WUE of 8.72 bushels/inch. Drew County producer Seth Tucker was second in the rice division growing furrow irrigated rice for the first time on his operation with yield of 203 bushels/acre and a WUE of 6.73 bushels/inch. Cross County producer Clint Boles placed third in rice growing furrow irrigated rice for the first time as well achieving a yield of 203 bushels/acre and WUE of 6.72 bushels/inch.

Awards for the winners were sponsored by Ricetec, the Arkansas Corn and Grain Sorghum Promotion Board, the Arkansas Soybean Promotion board, McCrometer, Seametrics, Delta Plastics, Irrometer, Trellis, and Agsense,

Each participant receives an individualized report card, providing feedback on their WUE and yield performance on their farm compared to the aggregated results from all the entries. The contest is strongly supported by the volunteer 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.

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 demonstration of Irrigation Water Management Practices at the county and local level.
- 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 is well distributed across the delta. Additionally, the winners are well distributed across geography of the state.

2020 Irrigation Yield Contest Field Map
Corn Locations

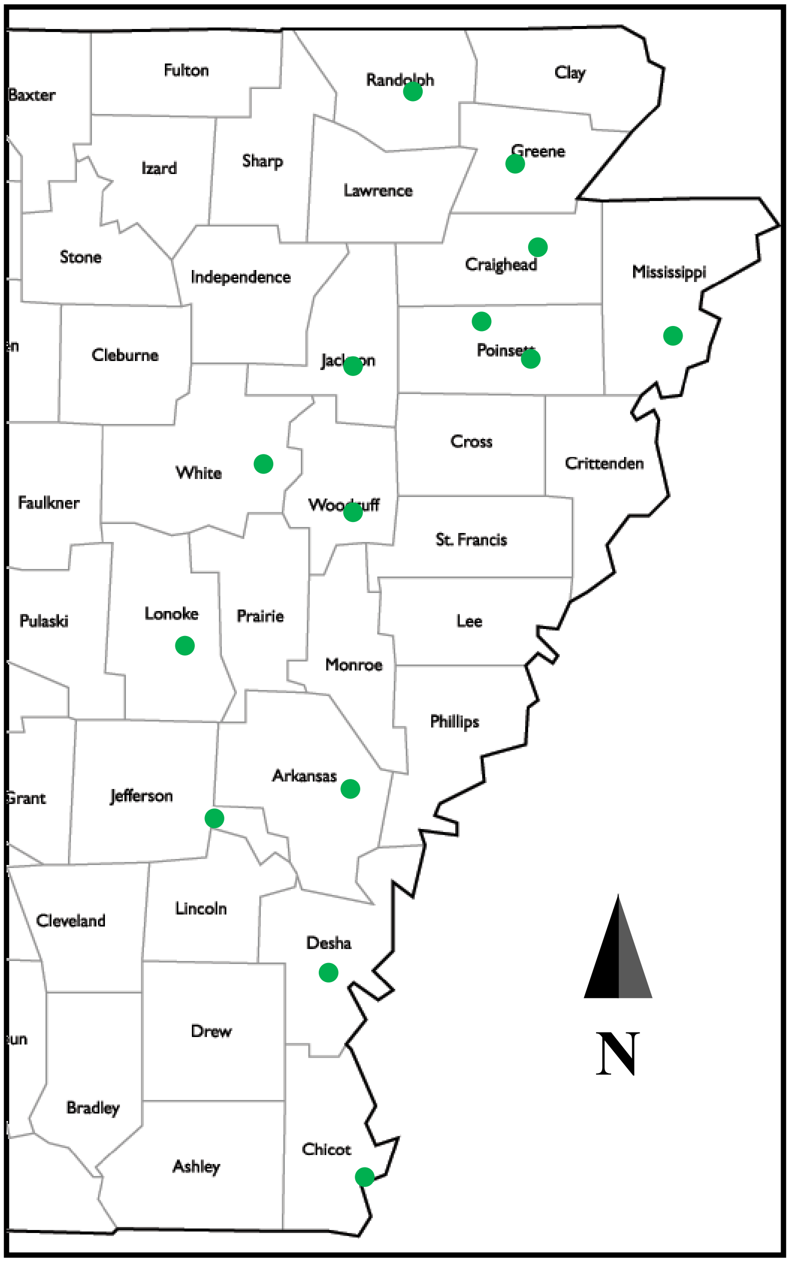


Figure 1. Geographic Distribution of Corn Contestants

2020 Irrigation Yield Contest Field Map
Soybean Locations

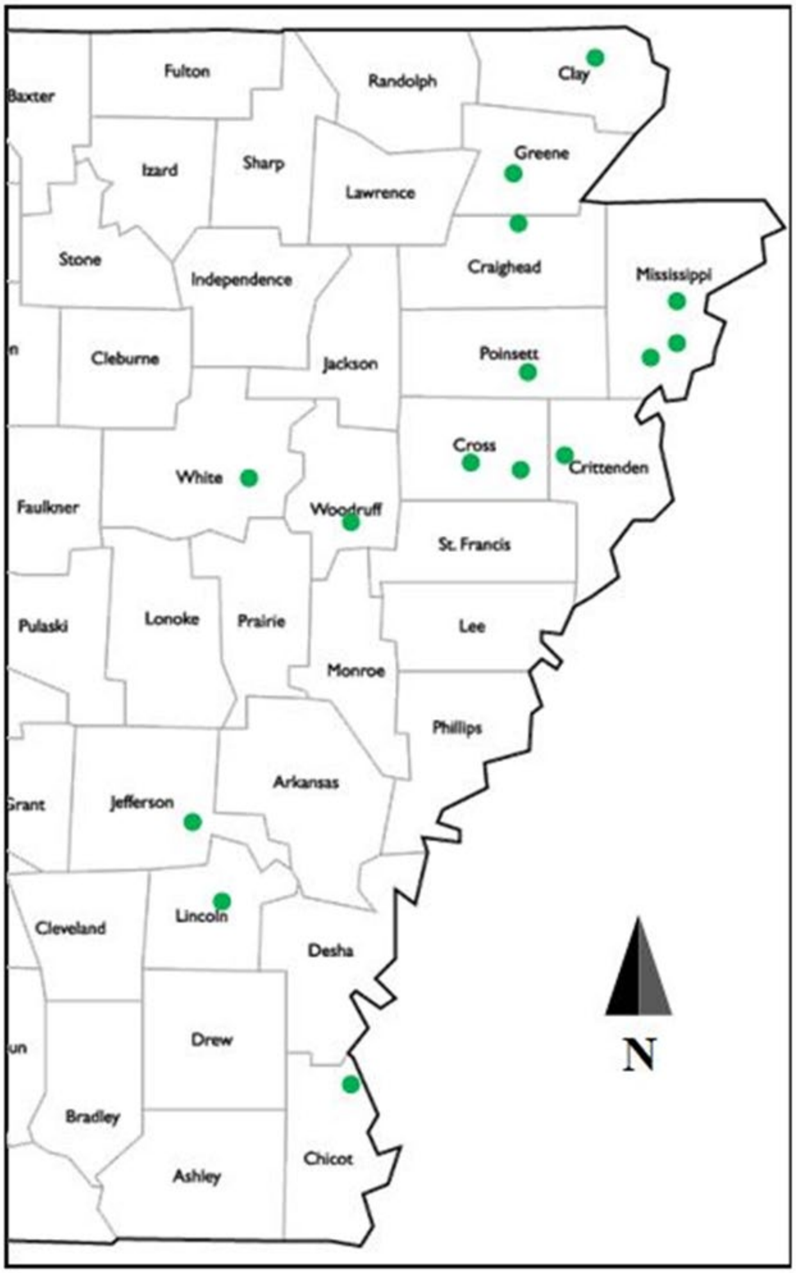


Figure 2. Geographic Distribution of Soybean Contestants

2020 Irrigation Yield Contest Field Map
Rice Locations

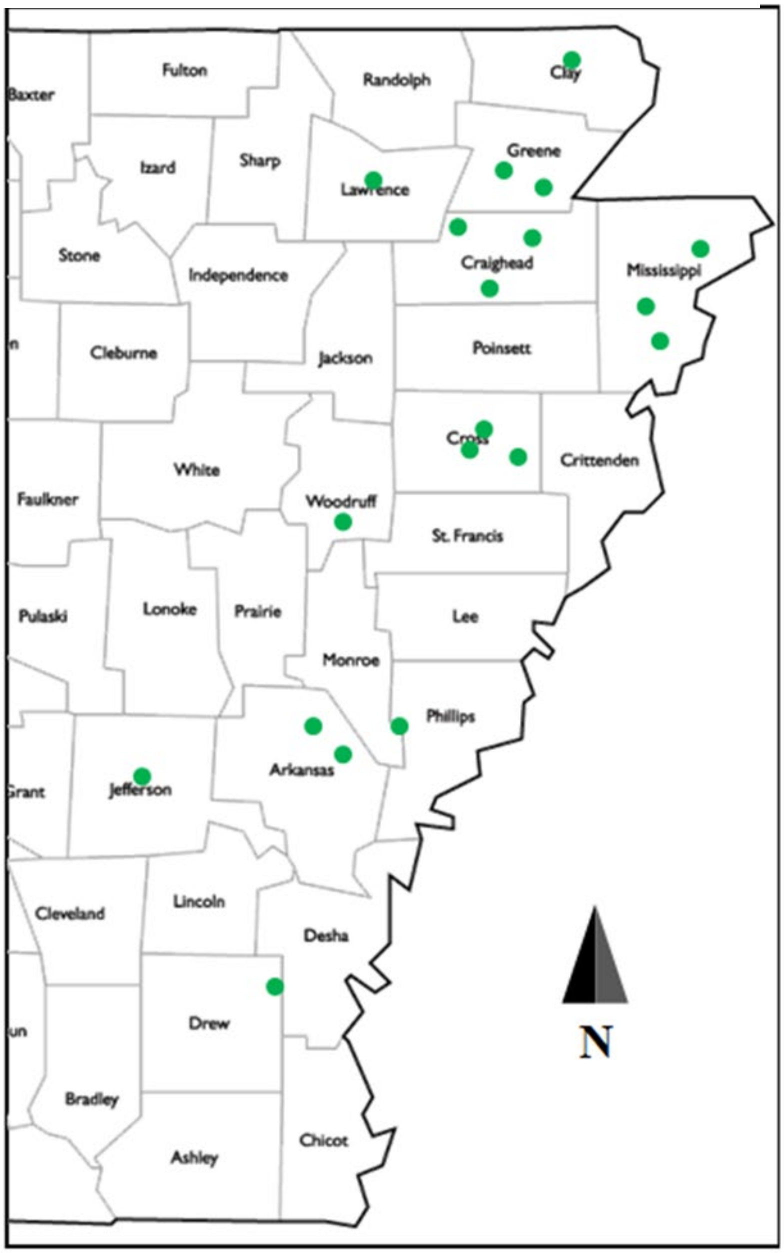
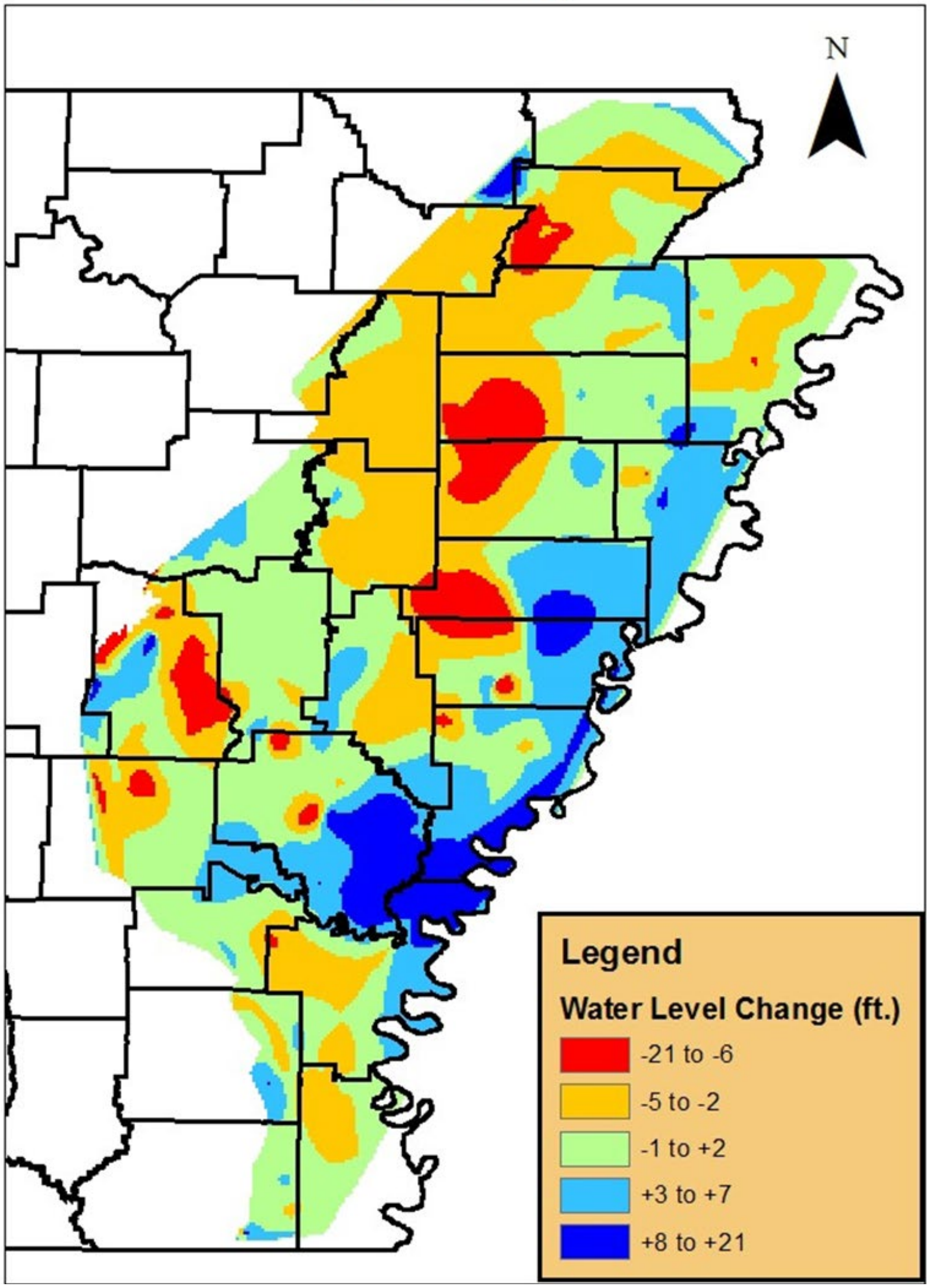


Figure 3. Geographic Distribution of Rice Contestants

10 - Year Water Level Change in the Arkansas Delta



Data Source: Arkansas Natural Resources District (Blake Forrest)

Figure 4. 10 Year Water Level Changes in Arkansas Delta

Materials and Methods

Rules were drafted in the spring of 2018 then edited 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 facilitates the contest, however a panel of impartial technical 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 for a specified amount of water input. Irmak defines Crop Water Use Efficiency as a benchmark water use efficiency where:

$$\mathbf{WUE_b = Y_i \, / \, (P_e + IR + \Delta \, SW)}$$

WUE_b = benchmark water use efficiency

Y_i = yield of irrigated crop (bu/ac)

P_e = effective rainfall (in)

IR = Irrigation applied (in)

Δ SW = change in soil water content in the root zone during the growing season (in)

(Irmak et al., 2011)

Equation 1

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. Even with this adjustment, there were only a few extreme events and the adjustment did not have any impact on the results in 2018, 2019 or 2020. In the future, more work is needed to develop a regionally specific adjustment for effective rainfall.

The equation (Equation 2) used to calculate the water use efficiency for each contestant is defined as the harvest yield estimate divided by the total water delivered to the field,

$\mathbf{WUE = Y / (P_e + IRR)}$ where,

WUE = Water Use Efficiency in bushels per inch

Y = Yield estimate from harvest in bushels per acre

P_e = Effective precipitation in inches.

IRR = Irrigation application in ac-inches/ac.

Equation 2

Meter Sealing

Irrigations were totalized using 8” and 10” portable propeller mechanical meters manufactured by McCrometer. Each meter was sealed using the following process.

Figure 5. 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 tap.

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 5 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 6).

Figure 6. Example of an alfalfa valve sealing done to exclude other sources.

Only mechanical propeller meters are used in the contest. They are required to have adequate straight run pipe before the impeller but can include vanes and flow straighteners if they meet the manufacture guidelines. For the winning entries, all meters are checked against a reference meter and must test within 5% of the reference meter, 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 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.

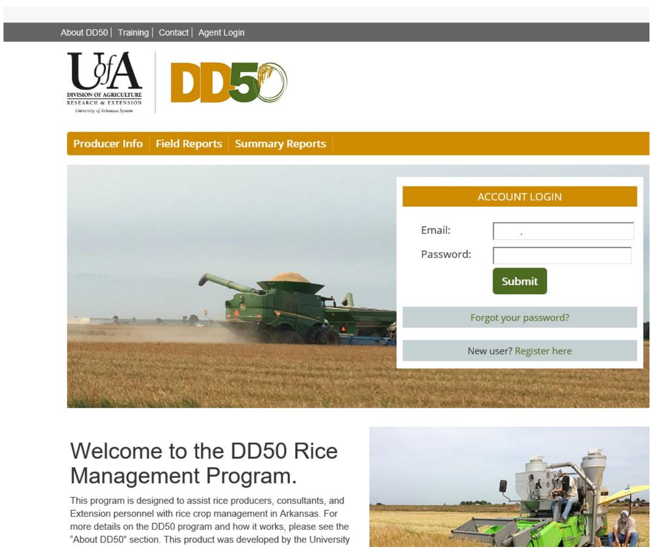


Figure 7. University of Arkansas DD50 Rice Website

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 8)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.

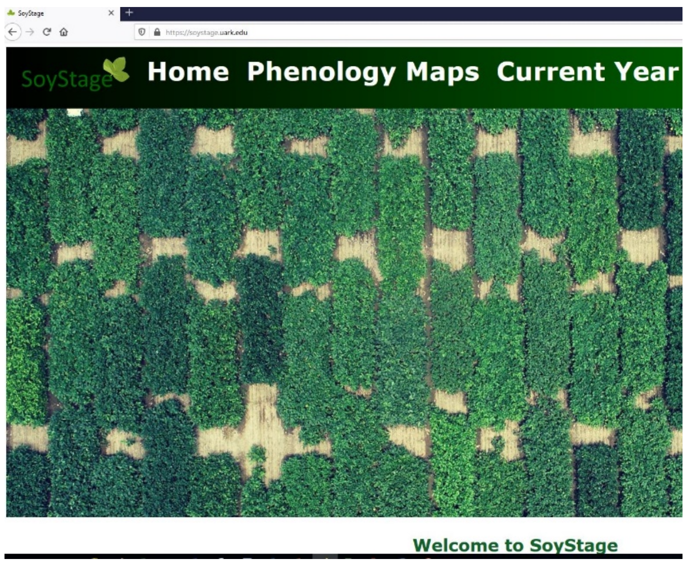


Figure 8. SoyStage website

Rainfall Estimation

Farmlogs™ (Ann Arbor, MI) and Climate Corporations Fieldview™(San Francisco, CA). 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. Farmlogs™, Climate Corporation Fieldview™ and twelve rain gauges were used throughout the irrigation season to collect rainfall accumulation. The rainfall values were added with total applied irrigation to get the total water use. An analysis was conducted to see if tipping bucket measurements at weather station locations were different from the two different commercially available computer model predictions. Figure 9 shows the total rain during the growing seasons the contest has been conducted.

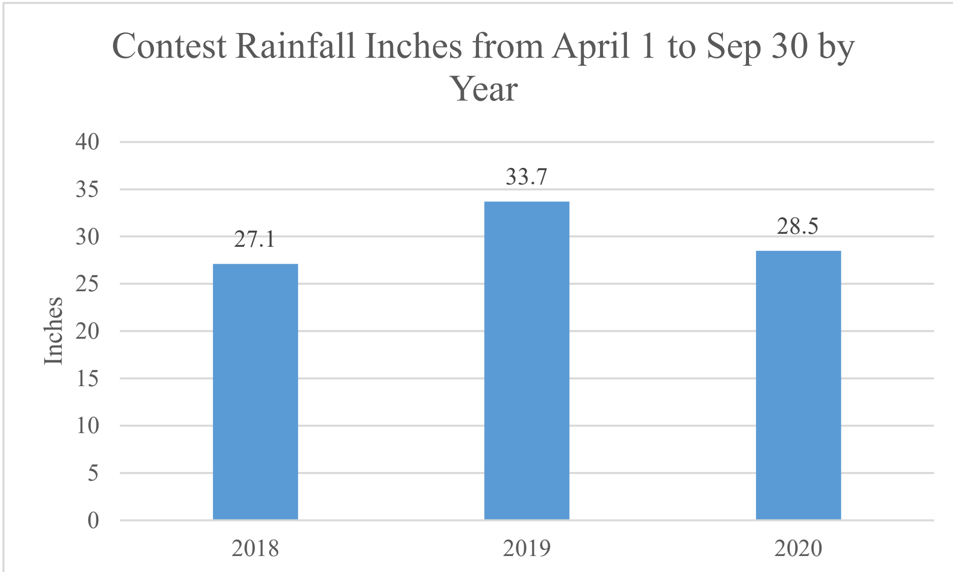


Figure 9. Average Total Rainfall for contest locations

The precipitation was assessed for each contest site utilizing two commercial rain prediction services, Farmlogs™ and Fieldview™. These services use 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.

Table 1. Rainfall from April 1 to September 30, 2020 comparing three methods.

	Rain bucket	Farmlogs™	Climate Corp Fieldview™
McGehee	30.7	31.7	32.8
Gould	37.1	30.7	31.2
Stuttgart	28.0	33.6	33.0
Carlisle	22.3	33.2	30.9
Keiser	20.6	23.3	20.7
Delaplaine	24.3	24.7	23.9
Mean	**28.1**	**29.5**	**28.8**

In 2020, rainfall data from April 1 to September 30, 2020 was collected at six locations, identified to have well maintained rain buckets and monitored during the growing season to provide a comparison to the rainfall prediction generated from Farmlogs™ and Fieldview™ during the growing season (Table 1 & Figure 10). Using an Analysis of Variance (ANOVA) no difference was found in the difference ($p=0.502$) in annual rainfall from the weather station measured data to the computer predictions.

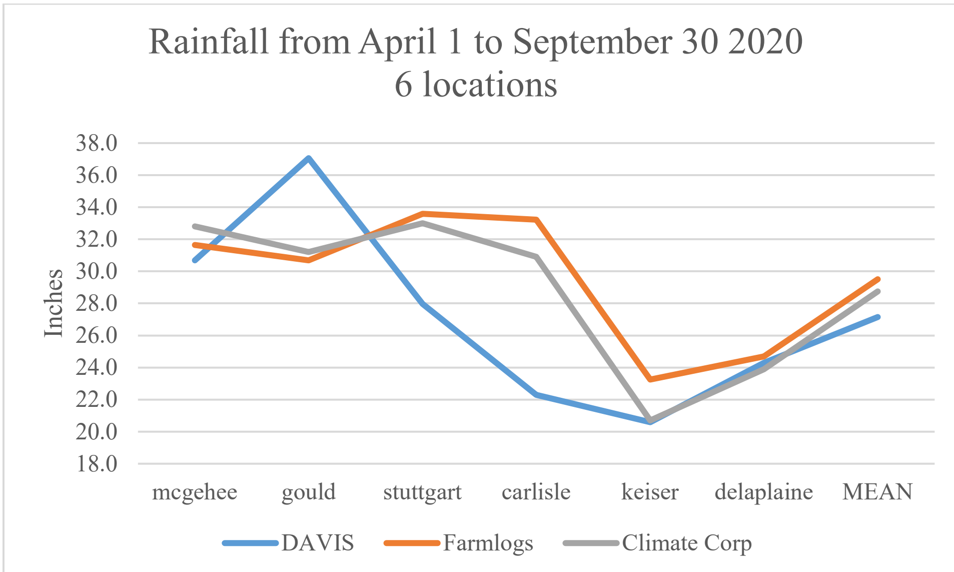


Figure 10. Rainfall from 6 weather station sources for 2020

For 2020, A 2-year comparison was analyzed as well with 18 locations from June 5 to August 31 have no significant difference between rain buckets, Farmlogs™, and Climate Corp Fieldview™ (Figure 11).

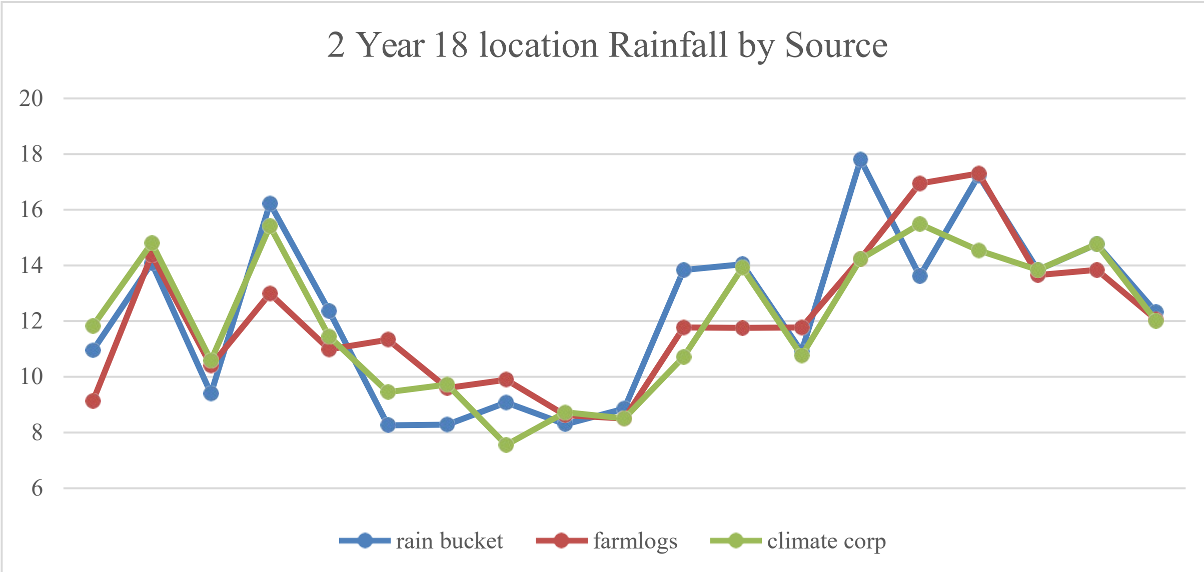


Figure 11. Two-year 18 location rainfall

Farmlogs™ and Fieldview™ produced similar results when compared to rain gauges. An absolute match was not necessary in terms of data accuracy because it was more important to collect rain information for every location from one method, but these two programs were used to check against each other for consistency. Also, for the contest, accumulated seasonal rainfall was considered more important than single event accuracy.

When deciding which computer model to use, the first source was the National Weather Service (NWS), but their data was more difficult to obtain because it is part of an estimation product that required some interfacing. Farmlogs™ was easier to use because rain data was provided in tabular form. Farmlogs™ utilizes raw weather data from the NWS then establishes a proprietary model to estimate precipitation for a given location. Climate Corp Fieldview™ application was found to be dependable as well for rain data collection. Retrieving data from Fieldview™ was more difficult and time consuming than Farmlogs™. A difference between the programs was that Fieldview™ reported more events but less rain per event, where Farmlogs™ reported fewer events but larger ones. For example, Fieldview™ reported several small events but the total would be near to one reported event by Farmlogs™. However, the difference in the total rainfall depth reported was not significantly different. Because of the ease in reporting, Farmlogs™ was used for the contest. Rainfall estimation seems to under report heavy rainfall events compared rain bucket data. However, Farmlogs™ seems to report high rainfall more often than Fieldview™. Table 2 shows the mean rain data comparing locations where tipping bucket rain stations are located and where predictions for Farmlogs^{TM} rainfall to Fieldview^{TM} rainfall estimates were compared.

The 2018 and 2019 18 locations of raw data were compared to the rain prediction services, Farmlogs^{TM} and Fieldview^{TM}. A one- way Analysis of Variance (ANOVA) was done to test if there were numerical differences between rain gage data and the estimates generated from Farmlogs^{TM} and Fieldviews^{TM}. The differences between the groups were not significantly different (p=0.95), and the data was found to have equal variances and normality. The lack of difference suggests that using the computer rainfall prediction method is a reliable way to determine rainfall contributions to contest fields. Additional data will be collected in future years to confirm the reliability and accuracy of this approach to rainfall estimation for the contest. At this time, it appears the current approach of using Farmlogs^{TM} to estimate season long rainfall is appropriate.

Table 2 shows the irrigation system type, maturity, planting date and season long rainfall for each of the contest categories, corn, rice, and soybeans. Most of the contestants use furrow irrigation and similar maturities for the contest.

Table 2. 2019 Contest Site Rainfall Amounts

Location	**Crop**	**Irrigation Type**	**Variety**	**Relative Maturity Or GDD**	**Planting Date**	**Rainfall Inches**
Payneway	corn	Furrow	DK 65-95	115	4/15/2020	15.2
Greenfield	corn	Furrow	mission 1857	115	4/8/2020	13.59
Tillar	corn	Furrow	H6714	117	4/28/2020	13.17
Bassett	corn	Furrow	DK 70-27	117	4/6/2020	16.21
Griffithville	corn	Furrow	Dynagro 57cc51	117	4/17/2020	18.49
Lake City	corn	Furrow	P1563	115	4/21/2020	12.07
Dewitt	corn	Furrow	Dynagro 58-65	118	4/4/2020	21.14
Eudora	corn	Furrow	Dynagro 57RR51	117	3/28/2020	17.8
Pine Bluff	corn	Furrow	Dynagro 57RR51	117	4/6/2020	16.74

Newport	corn	Furrow	P1870	118	4/17/2020	17.94
Walcott	corn	Furrow	DK 67-44	117	4/16/2020	13.67
Pocahontas	corn	Furrow	DKC 64-32	114	4/8/2020	15.51
Carlisle	corn	Furrow	DK 67-44	117	5/2/2020	13.72
Cotton Plant	corn	Furrow	HFG 1143	114	5/12/2020	21.4
Parkin	rice	Furrow	753	early	4/14/2020	14.24
Stuttgart	rice	AWD	753	early	4/17/2020	15.25
Sherrill	rice	Furrow	753	early	4/17/2020	17.96
Monticello	rice	Furrow	7521 FP	early	5/3/2020	16.14
Bono	rice	Furrow	753	early	4/21/2020	11.73
Hoxie	rice	AWD	753	early	4/9/2020	14.6
Mcdougal	rice	MIRI	gemini 214	early	4/16/2020	14.78
Wynne	rice	Furrow	7321 FP	early	4/10/2020	15.34
Burdette	rice	Furrow	7521 FP	med early	5/20/2020	12.07
Burdette	rice	Furrow	753	early	4/7/2020	13.3
Burdette	rice	Furrow	7521 FP	med early	4/10/2020	13.44
Burdette	rice	Furrow	CLXL 745	early	5/20/2020	12.06
Holly Grove	rice	MIRI	753	early	5/4/2020	17.23
Walcott	rice	Furrow	gemini214cl	early	5/7/2020	15.78
Lake City	rice	Furrow	gemini214cl	early	6/3/2020	12.58
Dyess	rice	Cascade	753	early	4/17/2020	12.64
Wynne	rice	Furrow	7521 FP	med early	5/25/2020	14.58
Paragould	rice	Furrow	7521 FP	med early	5/21/2020	14.89
River Road	rice	Furrow	7521 FP	early	5/8/2020	17.98
Whitton	rice	MIRI	CLM04	med early	5/15/2020	14.43
Valley View	rice	MIRI	753	early	5/15/2020	18.09
Cotton Plant	rice	Furrow	RT7301	early	6/11/2020	17.31
Lake Village	soybeans	Furrow	Credenz 4770	4.7	4/27/2020	15.67

Griffithville	soybeans	Furrow	NKS44-C7X	4.4	5/2/2020	16.3
Earle	soybeans	Furrow	AG48x9	4.8	5/8/2020	9.8
Mcdougal	soybeans	Furrow	AG46X6		4/7/2020	15.93
Burdette	soybeans	Furrow	Local4565	4.5	4/10/2020	14.46
Burdette	soybeans	Furrow	AG46X6	4.6	4/8/2020	13.44
Burdette	soybeans	Furrow	AG46X6	4.6	4/9/2020	13.44
Burdette	soybeans	Furrow	Local4565	4.5	4/9/2020	14.26
Lake City	soybeans	Furrow	LELAND	4.9	5/25/2020	13.76
Star City	soybeans	Furrow	P45A29 LL	4.5	5/4/2020	13.36
Pine Bluff	soybeans	Furrow	P48A60	4.8	4/10/2020	15.87
Wynne	soybeans	Furrow	P47A76LL	4.7	5/5/2020	11.69
Whitton	soybeans	Furrow	P48A60	4.8	4/17/2020	12.44
Payneway	soybeans	Furrow	P48A60	4.8	4/22/2020	13.64
Corning	soybeans	Furrow	A48XF0	4.8	6/11/2020	10.89
Parkin	soybeans	Furrow	Stine 48eb20	4.8	5/20/2020	14.58
Bassett	soybeans	Furrow	Local4565	4.5	4/10/2020	13.38
Cotton Plant	soybeans	Furrow	Stine 48eb23	4.8	6/4/2020	13.87
Walcott	soybeans	Furrow	Croplan 4641XF	4.6	6/13/2020	11.25

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 from a public grain buyer. The supervisor witnesses the full and tare weighing of the harvest truck.

Yields are adjusted to 12% moisture for rice, 13.5% for soybeans and 15% for corn. Foreign matter in excess of 1% is deducted from the yield. The winning entrants provided a yield map of the entire field entered to confirm that the entire field was irrigated the same as the harvest yield check. Area must be measured and certified by a supervisor. The corn and soybeans harvest were generally accomplished by measuring row lengths and width of cut. Measurements were taken using a digital rangefinder or a measuring wheel. Passes must be from the top to the bottom of the field with up to three harvest width passes taken of the top and bottom to facilitate harvest.

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 2020, minimum yield was set at 200 BPA for corn, 180 BPA for rice and 60 BPA for soybean. 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.

2020 Contest Participants & Field Requirements

The 2020 Arkansas Irrigation Yield Contest was conducted on 57 commercial fields that were 30 acres or larger from across the Arkansas Delta region. Twenty counties participated in the program: Arkansas, Chicot, Clay, Cross, Craighead, Crittenden, Desha, Drew, Greene, Jefferson, Jackson, Lawrence, Lincoln, Lonoke, Monroe, Mississippi, Poinsett, Phillips, Prairie, Randolph, Woodruff, and White counties totaling 2,700 acres. The field may have only one irrigation water source or riser to the field (multiple pumps may supply the field through a single hydrant). Table 3, Table 4, and Table 5 display the field characteristics and planting information for 54 of the entries. Entries are for rice, soybeans, and corn irrigated fields. A copy of the FSA Form 578, including farm summary were submitted with the contest entry form which confirms irrigation and production history. A contestant may enter the competition with more than one crop but may not win for more than one crop per year. The first-place winners in a crop 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 spouses) who support the contest are not allowed to enter in the respective commodity category contest.

Contest Field Characteristics are shown in Table 3 for corn, Table 4 for rice, and Table 5 for soybeans

Table 3. Contest Corn Field Characteristics

Producer	Previous Crop	Plant Pop	Energy Source	Water Source	Row Spacing	Genotype	Acres
1	soybeans	34000	electric	well	38	Dynagro 57RR51	35.6
2	corn	32000	electric	well	30	DK 67-44	35
3	soybeans	33000	electric	well	30	DK 67-44	58.1
4	soybeans	34000	electric	well	30	Dynagro 57cc51	42.4
5	soybeans	35000	diesel	well	38	H6714	81.8
6	soybeans	32000	electric	well	38	P1563	58
7	soybeans	34000	diesel	well	38	P1870	26
8	soybeans	32000	diesel	well	38	DK 65-95	30
9	soybeans	34000	electric	well	30	Dynagro 58-65	67
10	soybeans	34000	diesel	well	38	Dynagro 57RR51	95.6
11	soybeans	34000	electric	well	38	DK 70-27	38.5
12	soybeans	32000	electric	well	30	mission 1857	31.6
13	soybeans	34000	diesel	well	30	DKC 64-32	60.8
14	soybeans	35000	electric	well	38	HFG 1143	79.8

Table 4. Contest Rice Field Characteristics

Producer	***Irrigation Method***	***Previous Crop***	***Plant Pop***	***Energy Source***	***Water Source***	***Row Spacing***	***Acres***
1	Cascade	soybeans	500000	electric	well	7.5	44.09
2	AWD	soybeans	450000	diesel	well	7.5	70.6
3	Furrow	soybeans	450000	diesel	well	7.5	34.6
4	Furrow	soybeans	450000	electric	well	7.5	42.568
5	Furrow	soybeans	450000	electric	well	7.5	30
6	Furrow	soybeans	450000	electric	well	7.5	79
7	AWD	soybeans	450000	electric	well	7.5	45
8	Furrow	soybeans	450000	diesel	well	7.5	39.8
9	MIRI	soybeans	450000	diesel	well	7.5	39
10	Furrow	soybeans	500000	natural gas	well	7.5	36.3
11	Furrow	soybeans	450000	diesel	well	7.5	44.9
12	MIRI	corn	900000	electric	well	7.5	35.3
13	Furrow	soybeans	450000	electric	well	7.5	38.5
14	Furrow	soybeans	450000	electric	well	7.5	44.4
15	Furrow	soybeans	150000	electric	well	38	55.8
16	MIRI	rice	450000	electric	well	7.5	102.5
17	Furrow	soybeans	500000	natural gas	well	7.5	68
18	Furrow	soybeans	500000	natural gas	well	7.5	16.2
19	Furrow	peanuts	450000	diesel	well	7.5	27
20	Furrow	soybeans	450000	electric	well	7.5	40
21	MIRI	soybeans	450000	diesel	well	7.5	38
22	Furrow	soybeans	500000	natural gas	well	7.5	43.2

Table 5. Contest Soybean Field Characteristics

Producer	Previous crop	Energy Source	Water Source	Spacing	Genotype	Acres
1	rice	electric	well	30	A48XF0	30
2	rice	diesel	well	38	P45A29 LL	30.1
3	rice	natural gas	well	38	AG46X6	35.5
4	corn	electric	well	38	P48A60	61
5	corn	electric	well	30	P47A76LL	37.4
6	corn	electric	well	30	Croplan 4641XF	50
7	rice	natural gas	well	38	AG46X6	39.3
8	corn	electric	well	38	AG48x9	33.25
9	corn	electric	well	38	P48A60	34
10	corn	diesel	well	38	P48A60	32.3
11	rice	natural gas	well	38	Local4565	49.5
12	rice	diesel	well	38	Credenz 4770	56.2
13	rice	diesel	well	38	A46X6	120
14	rice	natural gas	well	30	Local4565	55.9
15	soybeans	diesel	well	38	Local4565	31
16	soybeans	diesel	well	38	Stine 48eb20	31.9
17	corn	diesel	well	38	Stine 48eb23	105.2
18	rice	diesel	well	38	LELAND	35.7

Description of Awards

Participants were awarded for highest water use efficiency in each crop category (Corn, Soybean, & Rice). is given to each of the nine winners that contain various cash prizes and or products from the sponsors who generously contributed to the contest. Table 6 highlights the prizes for the winners. Additional support for the program has been provided by McCrometer, through a discount program to provide meters for the contest in addition to providing 10" flowmeters to the winners. In total over $62,809 in cash and products are distributed to the winners of the contest.

Table 6. Prizes Awarded

Rice Division	Corn Division	Soybean Division
$11,000 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 Corn and Grain Sorghum 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 Corn and Grain Sorghum Promotion Board
$2,000 in cash from Delta Plastics		

For First Place Winners of the Corn, Rice and Soybean Division Prizes	
	Irrometer manual reader and three watermark sensors $325 in product retail value plus $500 cash $2,475 in Total

10” Mccrometer portable flow meter with a FS-100 Flow Straightener

$2,271 in product retail value

$6813 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

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 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 7 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. Computerized Hole Selection is 100% adopted by contestants. The data from entry forms is incomplete buts 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 7. Percent of Contestants Using Irrigation Technologies in Contest Field

	Soil Moisture Sensors	*Pipe Planner*	*Furrow Irrigated Rice*
2020	42%	100%	73%
2019	40%	43%	38%
2018	50%	73%	50%

Contest 3 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 115 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 three years the contest was conducted, but it is difficult to infer trends in WUE over the years due to the variation among contestants' results. A wide range of management styles and field conditions are represented. Figure 12, Figure 13, and Figure 14 show the distribution of WUE over the three years.

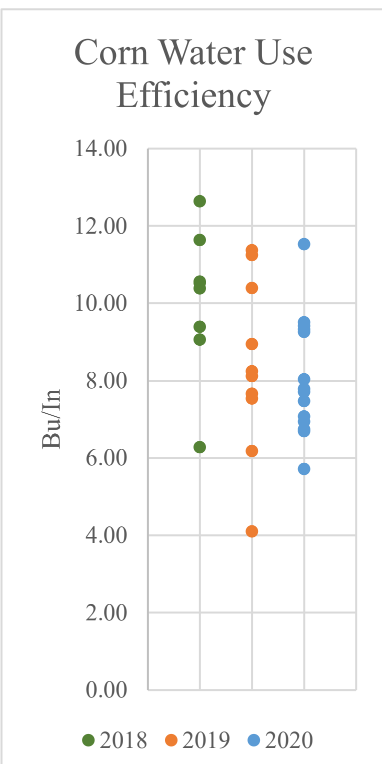


Figure 14. Corn WUE

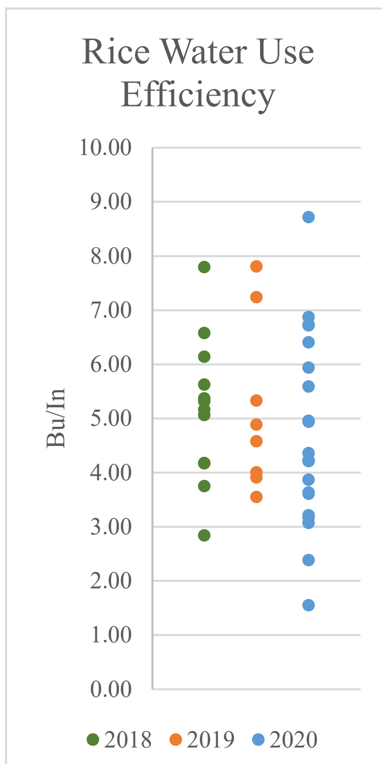


Figure 13. Rice WUE

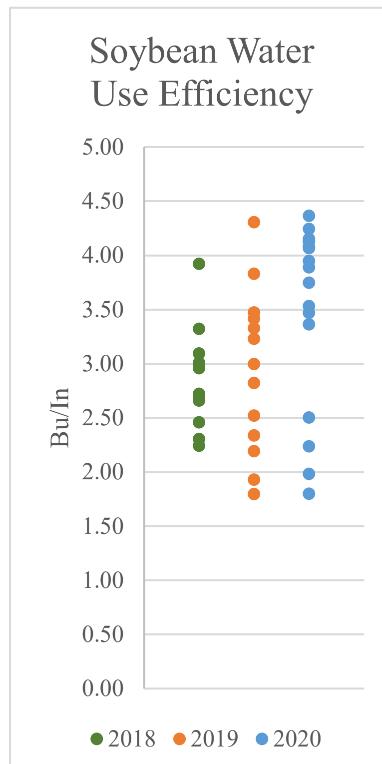


Figure 12. Soybean WUE

The data was then combined from all three years for each crop. This data can be seen in Table 8 for soybeans, Table 9 for rice, Table 10 for corn. The average WUE over the 3-year period for soybean was 3.15 Bu/In, the average for corn was 8.67 Bu/In, and the average for rice was 4.92 Bu/In.

In the calculation for WUE 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 rainwater and irrigation water. By plotting rainfall against WUE using all three years, linear regression and goodness of fit was determined. Across all three crop types, no linear relationship was found between rainfall and WUE (Figure 15). Adjusted rainfall is used in this calculation because it was what was used in determine the WUE, but less than ten of the 115 data points have an adjusted rainfall that differs from the recorded rainfall. Thus, the amount of rainfall received is not a factor in the WUE results.

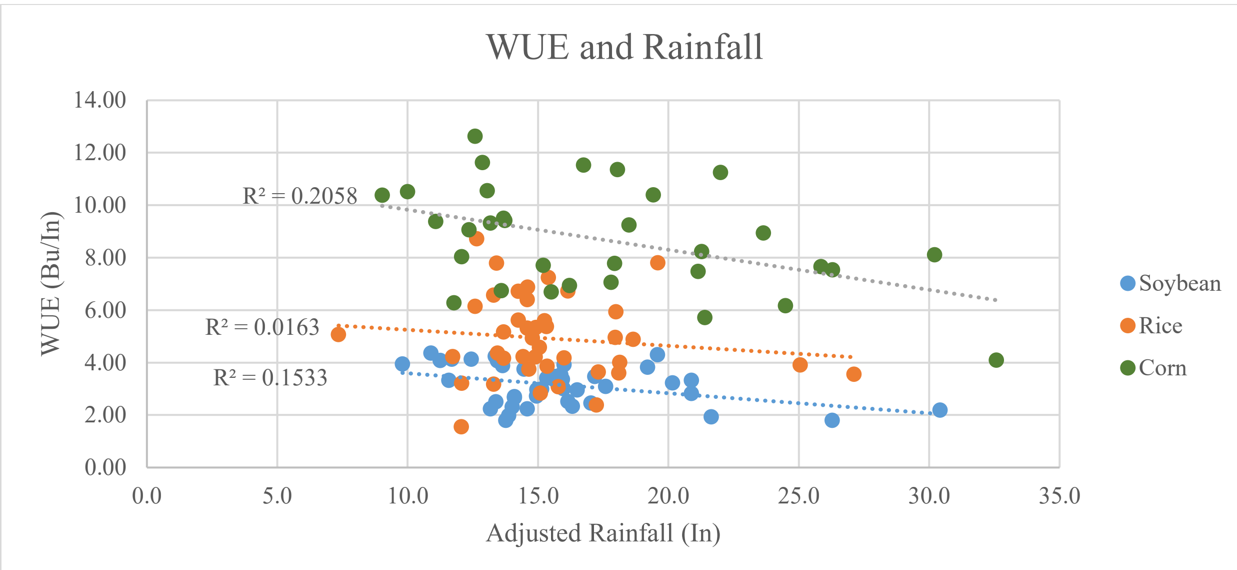


Figure 15. Rainfall and WUE

Another misconception is a better WUE can be achieved with higher yields and alternatively it is better to have lower yields for a higher WUE. 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 16. Across all three crop types there is no significant relationship between yield and WUE. While it may appear visually 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 had some sort of crop failure. This causes a normal amount of water to be used with a below normal yield resulting in a lower WUE. Thus, the yield obtained is not a significant factor in the end WUE for a contest entry.

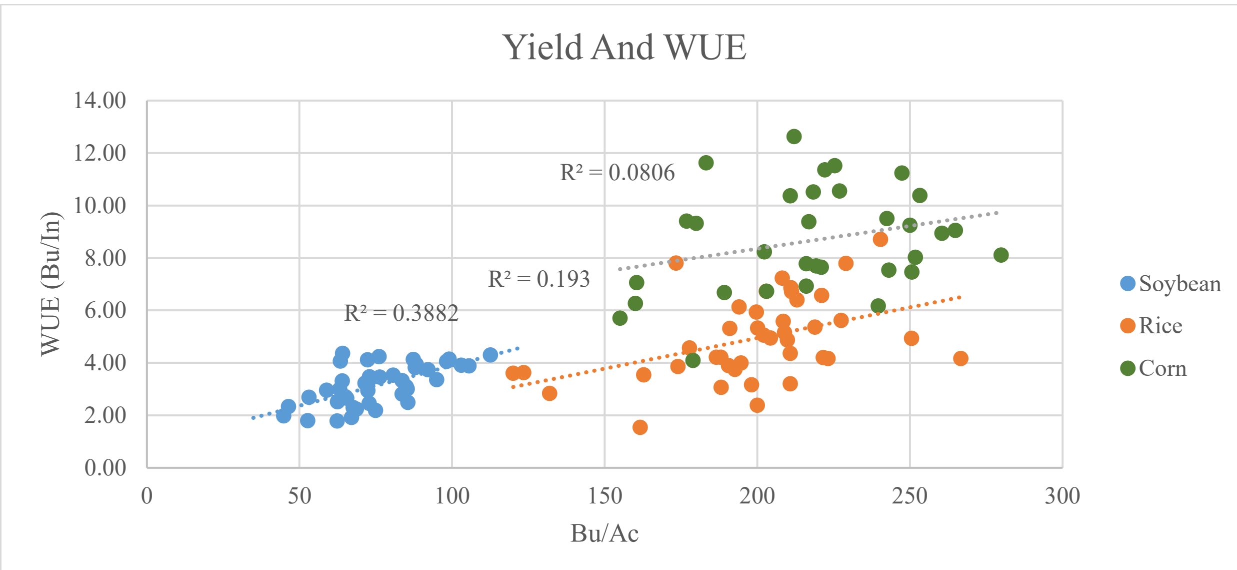


Figure 16. Yield and WUE

Table 8.Three Year Soybean Data

Yield (Bu/Ac)	Applied Irrigation (Ac-In/Ac)	Adjusted Rainfall (In)	Total Water (In)	WUE (Bu/in)	
64	3.8	10.9	14.7	4.37	
112	6.5	18.9	26.1	4.31	
76	4.6	13.4	17.9	4.25	
99	10.4	13.4	23.8	4.15	
87	8.7	12.4	21.1	4.13	
72	5.8	11.7	17.5	4.13	
63	4.3	11.3	15.5	4.08	
98	10.7	13.4	24.1	4.07	
88	12.5	9.8	22.3	3.95	
103	10.3	16.0	26.3	3.92	
106	13.5	13.6	27.1	3.89	
88	3.8	19.3	23.0	3.83	
92	10.1	14.5	24.6	3.75	
81	7.0	15.9	22.8	3.53	
73	3.8	19.2	21.0	3.47	
76	6.3	15.7	22.0	3.47	
73	6.1	15.6	21.5	3.42	
95	12.3	15.9	28.2	3.36	
84	4.2	18.6	25.1	3.33	
64	7.7	11.6	19.3	3.32	
71	2.0	18.9	22.1	3.23	
85	9.9	17.6	27.5	3.09	
85	12.4	16.0	28.4	3.01	
63	6.0	14.3	21.1	3.00	
59	4.9	15.0	19.8	2.97	
72	8.0	16.5	24.5	2.96	
84	8.7	18.6	29.6	2.82	
65	8.9	14.9	23.9	2.72	
53	5.6	14.1	19.7	2.70	
65	10.5	14.1	24.6	2.66	
62	8.7	17.6	24.8	2.52	
85	20.8	13.4	34.1	2.50	
73	12.6	17.0	29.6	2.46	
46	3.5	18.3	19.8	2.34	
68	15.3	14.0	29.3	2.31	
69	17.4	13.2	30.6	2.24	
68	16.0	14.6	30.5	2.24	
75	3.7	26.6	34.2	2.19	
45	8.8	13.9	22.6	1.98	
67	13.1	20.0	34.7	1.93	
53	15.5	13.8	29.3	1.80	
62	8.4	24.1	34.7	1.80	
76	**8.9**	**15.9**	**24.8**	**3.15**	**Average**

Table 9. Three Year Rice Data

Yield (Bu/Ac)	Applied Irrigation (Ac-In/Ac)	Adjusted Rainfall (In)	Total Water (In)	WUE (Bu/In)	
240	14.9	12.6	27.6	8.72	
173	2.6	19.2	22.2	7.81	
229	16.0	13.4	29.4	7.80	
208	13.4	13.2	28.7	7.24	
211	16.1	14.6	30.7	6.87	
203	14.0	16.1	30.1	6.73	
211	17.2	14.2	31.4	6.72	
221	20.3	13.3	33.6	6.58	
213	18.7	14.6	33.3	6.40	
194	19.0	12.6	31.6	6.14	
200	15.6	18.0	33.6	5.94	
227	26.2	14.2	40.4	5.63	
208	22.0	15.3	37.3	5.59	
219	25.4	15.3	40.8	5.37	
200	22.6	15.4	37.5	5.33	
191	21.3	14.6	35.9	5.32	
209	20.3	13.7	43.4	5.17	
202	32.6	7.4	39.9	5.06	
204	23.2	18.0	41.2	4.96	
250	35.9	14.8	50.7	4.94	
210	24.3	16.9	43.0	4.89	
178	23.8	12.7	38.8	4.58	
211	34.9	13.4	48.3	4.36	
188	30.1	14.4	44.5	4.22	
187	32.4	11.7	44.2	4.22	
222	37.7	14.9	52.6	4.21	
267	47.9	16.0	63.8	4.18	
223	39.8	13.7	53.5	4.17	
195	30.5	16.1	48.6	4.00	
191	23.7	23.1	48.7	3.91	
174	29.7	15.3	45.0	3.87	
193	36.7	14.6	51.3	3.75	
123	16.6	17.3	33.9	3.64	
120	15.2	18.1	33.2	3.61	
163	18.7	24.0	45.8	3.55	
211	53.5	12.1	65.6	3.21	
198	49.1	13.3	62.4	3.17	
188	45.4	15.8	61.2	3.07	
132	31.4	15.1	46.4	2.84	
200	66.6	17.2	83.8	2.39	
162	92.1	12.1	104.2	1.55	
199	**28.7**	**15.4**	**44.3**	**4.92**	**Average**

Table 10. Three Year Corn Data

Yield (Bu/Ac)	Applied Irrigation (Ac-In/Ac)	Adjusted Rainfall (In)	Total Water (In)	WUE (Bu/In)	
212	4.2	12.6	16.8	12.63	
183	2.9	12.9	15.8	11.63	
225	2.8	16.7	19.6	11.53	
222	18.0	1.5	19.5	11.36	
247	22.1	0.0	22.0	11.24	
227	8.4	13.1	21.5	10.55	
218	10.8	10.0	20.8	10.52	
253	19.4	5.0	24.4	10.39	
211	11.3	9.0	20.3	10.38	
242	11.8	13.7	25.5	9.51	
177	5.1	13.7	18.8	9.42	
217	12.0	11.1	23.1	9.38	
180	6.1	13.2	19.3	9.32	
250	8.5	18.5	27.0	9.25	
265	16.9	12.4	29.2	9.06	
260	23.6	5.5	29.1	8.94	
202	21.3	3.3	24.6	8.24	
280	30.9	4.3	34.5	8.11	
252	19.3	12.1	31.3	8.03	
216	9.8	17.9	27.7	7.79	
219	13.2	15.2	28.4	7.71	
221	27.3	3.0	28.9	7.65	
243	26.3	6.0	32.3	7.54	
251	12.4	21.1	33.5	7.47	
160	4.9	17.8	22.7	7.07	
216	14.9	16.2	31.1	6.94	
203	16.5	13.6	30.1	6.74	
189	12.8	15.5	28.3	6.69	
160	13.7	11.8	25.5	6.27	
240	24.7	14.3	38.8	6.17	
155	5.7	21.4	27.1	5.71	
179	34.8	11.1	43.6	4.10	
218	**14.8**	**17.6**	**26.3**	**8.67**	**Average**

Contest Results

Contest 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.

Figure 17 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 3.59 bushels per inch, the rice category averaged 4.69 bushels per inch and corn averaged 8.08 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.

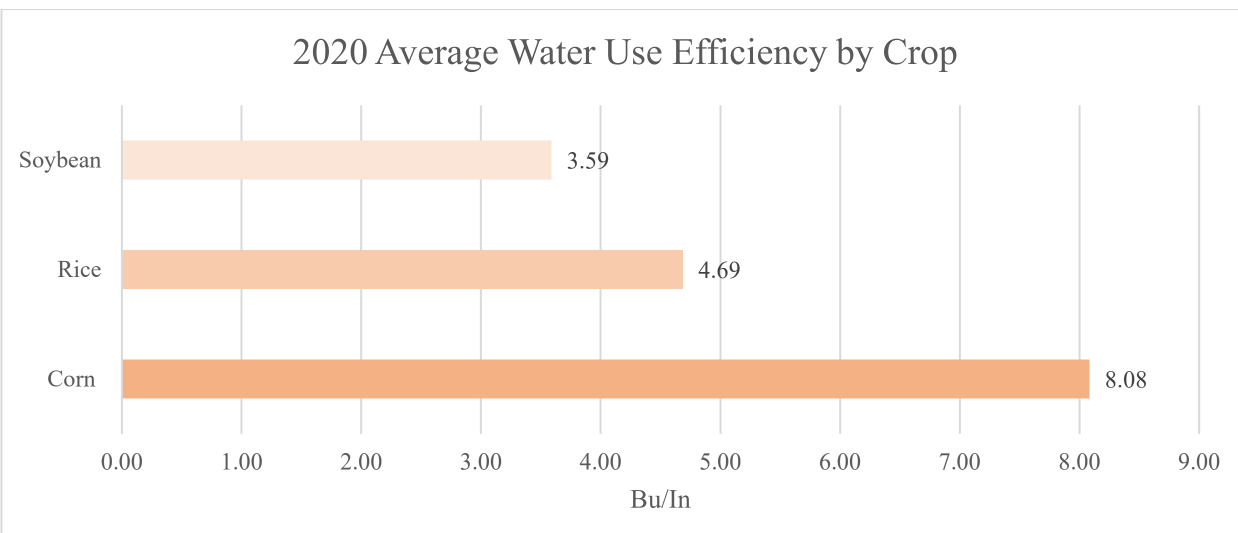


Figure 17. Average 2020 Water Use Efficiency by Crop

Corn Contest Results

Table 11. Corn Yield and Water Use Efficiency

Grower	Variety Selection	Yield (Bushels per Acre)	Irrigation (ac – in/ac applied)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels per Inch)
1	Dynagro 57RR51	225.35	2.81	16.74	16.74	19.55	11.53
2	DK 67-44	242.49	11.84	13.67	13.67	25.51	9.51
3	DK 67-44	176.79	5.06	13.72	13.72	18.78	9.42
4	H6714	180.00	6.14	13.17	13.17	19.31	9.32
5	Dynagro 57cc51	249.94	8.53	18.86	18.49	27.02	9.25
6	P1563	251.75	19.27	12.07	12.07	31.34	8.03
7	P1870	216.00	9.80	17.94	17.94	27.74	7.79
8	DK 65-95	219.26	13.25	15.20	15.20	28.45	7.71
9	Dynagro 58-65	250.64	12.41	21.55	21.14	33.55	7.47
10	Dynagro 57RR51	160.41	4.90	17.80	17.80	22.70	7.07
11	DK 70-27	216.05	14.94	16.21	16.21	31.15	6.94
12	mission 1857	203.00	16.53	13.59	13.59	30.12	6.74
13	DKC 64-32	189.20	12.76	15.51	15.51	28.27	6.69
14	HFG 1143	155.00	5.73	22.15	21.40	27.13	5.71
Mean		**209.71**	**10.28**	**16.30**	**16.19**	**26.47**	**8.08**

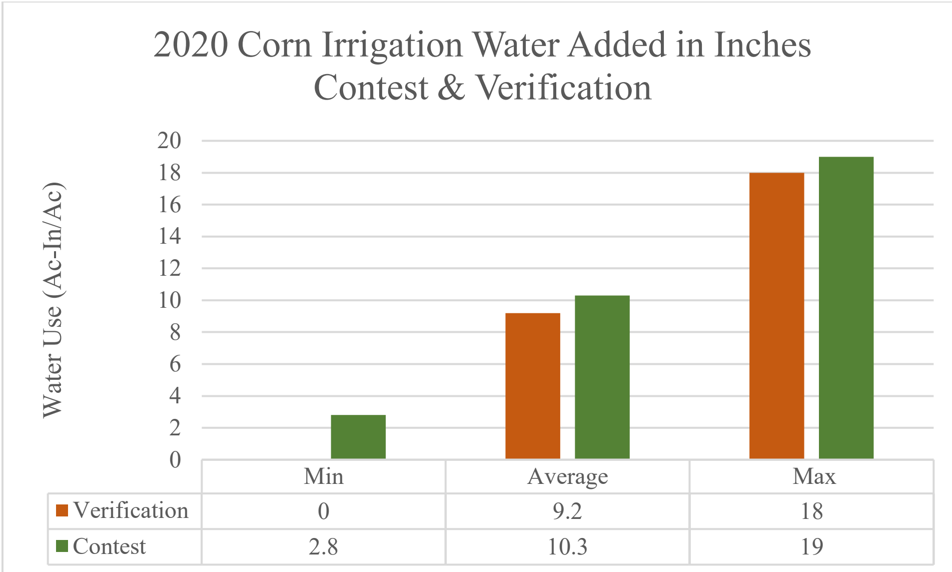


Figure 18. Contest Average Water Use and Verification Water Use

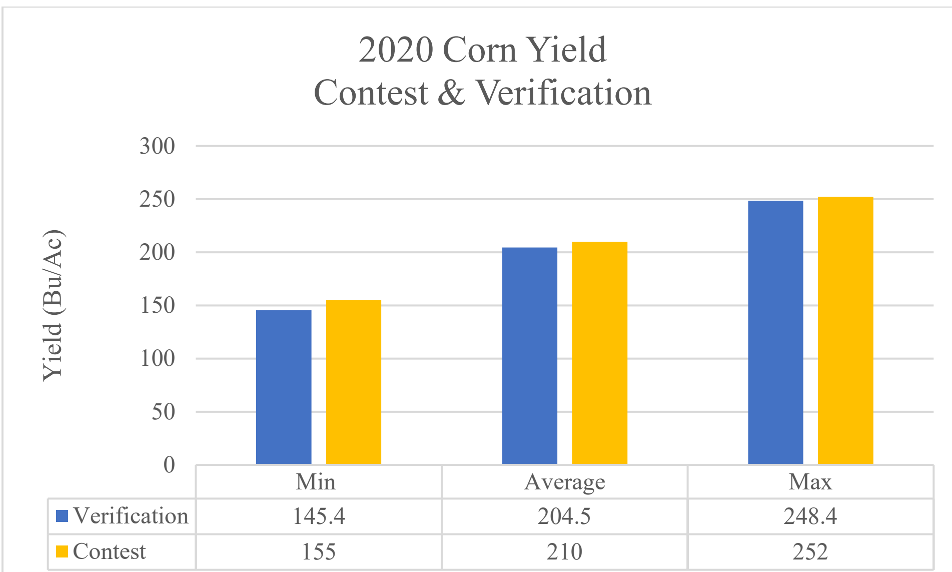


Figure 19. 2020 Contest and Verification Yield

Overall, fourteen corn fields were entered into the contest. The irrigation water use (Figure 18) and yields (Figure 19) were similar to the University of Arkansas Corn and Grain Sorghum verification program results (University of Arkansas, 2019). The average yield of corn grown for the contest was 211 BPA and the average water use efficiency of corn grown for the contest was 8.08 bushels/inch (Table 11). This average yield was 17% higher than the state average for 2019 of 181 BPA (USDA National Agricultural Statistics Service, 2018). Corn yield was corrected to 15% moisture for every field. None of the fields had a Foreign Matter (FM) grade high enough, above 1 percent, to require dockage/adjustment.

The highest yielding corn field was in Craighead County with a yield of 253 BPA. The water use efficiency ranged from a high of 11.5 bushels/inch to a low of 5.7 bushels/inch. The average irrigation water added to corn contest fields was 10.3 inches. The highest irrigation water added to a corn contest field was 19.3 inches and the lowest irrigation water added was the winner (Chad Render) with 2.8 inches of irrigation.

Figure 20. Chad Render (Center) With Scott Crabb on Left and Kurt Beaty on Right

Render (Figure 20) says, "NRCS asked us to try the cover crops, Pipe Planner, and sensors and it worked. We are a family farm near Tamo Lake and Noble Lake in south Jefferson County. Faith and Family are very important to us. We help one another, when I do well we all do well. We have excellent landlords and farm workers. I watched the weather and saved the irrigation applications for reproductive growth stages. The contest field has two soil types, Roxana and Coushatta silt loam."

Render planted early and received an average amount of rainfall. He also applied the least amount of irrigation. While his yield was not the highest, Chad Render achieved the highest water use efficiency. He uses sensors on the farm, but they were not in the contest field. He attended the Extension irrigation water management meeting at Dumas in February 2020 to build his first sensors.

Figure 21. Greene County Producers Clay (Center Left) & Terry (Center Right) Smith with George Smith (Left) and Supervisor Austin Miller (Right)

The father and son duo Terry & Clay Smith (Figure 21) of Greene County made a successful run with their corn contest crop achieving a WUE of 9.51 bushels/inch. Smith "We made use of cover crops to achieve a higher water use efficiency as well as surge valves and soil moisture sensors on our contest field. We only watered when the moisture sensors indicated the field needed water" said Terry. "When we compared the contest field to a nearby field that was similar but was watered based on our normal irrigation schedule, the competition field required roughly half the water." Terry Says "We've always done on-farm trials. The irrigation contest is an extension of that. We want to use water efficiently and other resources to be more sustainable and more profitable."

Brandon Cain (Figure 22) placed third in the corn division with a WUE of 9.25 bushels/inch. "I use computerized hole selection to ensure uniform water application across the field. I did not use soil moisture sensors on my competition field but instead used sensors on a nearby field to determine when I should irrigate." The technology was in his adjacent University of Arkansas Corn Verification field which contributed to the successful results. "I use soil moisture sensors on a select few fields and then can use the information to base irrigation scheduling for the rest of the farm." "I use Pipe Planner to ensure uniform water application across the field." His soil is Calloway silt loam. Brandon says "Pipe Planner really did the most to help me irrigate these fields better. Everything costs money and your time is more valuable than you think. We save labor and therefore we are making money by saving money"

His soil is Calloway silt loam.

Figure 22. White County Producer Brandon Cain and County Agent Jan Yingling

Rice Contest Results

The Rice Irrigation Contest produced a broad range of results in terms water use between the producers. In 2020, 6 of the rice fields practiced multiple inlet irrigation achieving an average of 196 BUA and 3 practiced Alternate Wetting and Drying (AWD) irrigation that produced an average yield of 210 BPA. Furrow irrigated rice was used in 15 contest fields with an average yield of 200 BPA and an average WUE of 4.35 bushels/inch (Table 12). All rice contest fields planted RiceTec hybrids seed except for one which was planted with CLM04. Tabular results from the rice contest are shown in Table 13**.** Five entries did not meet the minimum yield. Nine fields were planted with RT XP753, one field was planted with RT 7311 Clearfield and one field was planted with CLM04, three fields were planted with Gemini 214C, one field was planted with RT7321 FP. Six fields were planted with RT7521 FP and one field was planted with RT CLXL745.

The average rice yield in the contest was 196 BPA and the average rice water use efficiency was 4.1 bushels/inch. The yield average for the rice contest was 17% higher than the state average rice yield of 167 BPA for 2019 (USDA National Agriculture Statistics Service, 2018).

Table 12. Furrow and Flood 3 Year Averages

	AVERAGE YIELD (BU/AC)	**AVERAGE WATER ADDED (AC-IN/AC)**
FLOOD/AWD/MIRI	206.4	25.3
FURROW	194.7	31.0

Table 13. 2020 Rice Yield and Water Use Efficiency

Grower	Irrigation Method	Variety Selection	Yield (Bushels/ Acre)	Irrigation Applied (ac-in/ac)	Rain (in) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (in)	WUE (Bushels/ inch)
1	Cascade	753	240	14.9	12.6	12.6	27.6	8.72
2	AWD	753	211	16.1	14.6	14.6	30.7	6.87
3	Furrow	7521 FP	203	14.0	16.1	16.1	30.1	6.73
4	Furrow	753	211	17.2	14.2	14.2	31.4	6.72
5	Furrow	7521 FP	213	18.7	14.6	14.6	33.3	6.40
6	Furrow	7521 FP	200	15.6	18.0	18.0	33.6	5.94
7	AWD	753	208	22.0	15.3	15.3	37.3	5.59
8	Furrow	753	204	23.2	18.0	18.0	41.2	4.96
9	MIRI	gemini 214	250	35.9	14.8	14.8	50.7	4.94
10	Furrow	7521 FP	211	34.9	13.4	13.4	48.3	4.36
11	MIRI	CLM04	188	30.1	14.4	14.4	44.5	4.22
12	Furrow	753	187	32.4	11.7	11.7	44.2	4.22
13	Furrow	7521 FP	222	37.7	15.1	14.9	52.6	4.21
14	Furrow	7321 FP	174	29.7	15.3	15.3	45.0	3.87
15	Furrow	RT7301	123	16.6	17.3	17.3	33.9	3.64
16	MIRI	753	120	15.2	18.1	18.1	33.2	3.61
17	Furrow	7521 FP	211	53.5	12.1	12.1	65.6	3.21
18	Furrow	753	198	49.1	13.3	13.3	62.4	3.17
19	Furrow	gemini214cl	188	45.4	15.8	15.8	61.2	3.07
20	MIRI	753	200	66.6	17.2	17.2	83.8	2.39
21	Furrow	CLXL 745	162	92.1	12.1	12.1	104.2	1.55
MEAN			**196**	**32**	**15**	**15**	**47**	**5**

The average yield for all rice fields were corrected to 12% moisture. Yields in the rice contest ranged from a high of 250 BPA (flooded rice) to a low of 120 BPA (flooded rice). The average irrigation water added for all contest rice fields was 32 inches. The highest irrigation water applied to a contest rice field was 92 inches and the lowest amount of irrigation water added to a contest rice field was 14 inches (Table 13).

The average WUE was 5 Bu/in. The results from the contest were compared to the published report for the University of Arkansas Verification Report for 2019 to compare the irrigation water use and average yields from the program to the contest (University of Arkansas 2019). The average irrigation water was 27 ac-in/ac for the verification program fields and 32 ac-in/ac for contest fields (Figure 23). The average yield in the verification program fields was 183.4 bushels per acre and 196 bushels per acre for the contest fields (Figure 24). The minimum yield of 180 BPA appears to be a fair minimum yield.

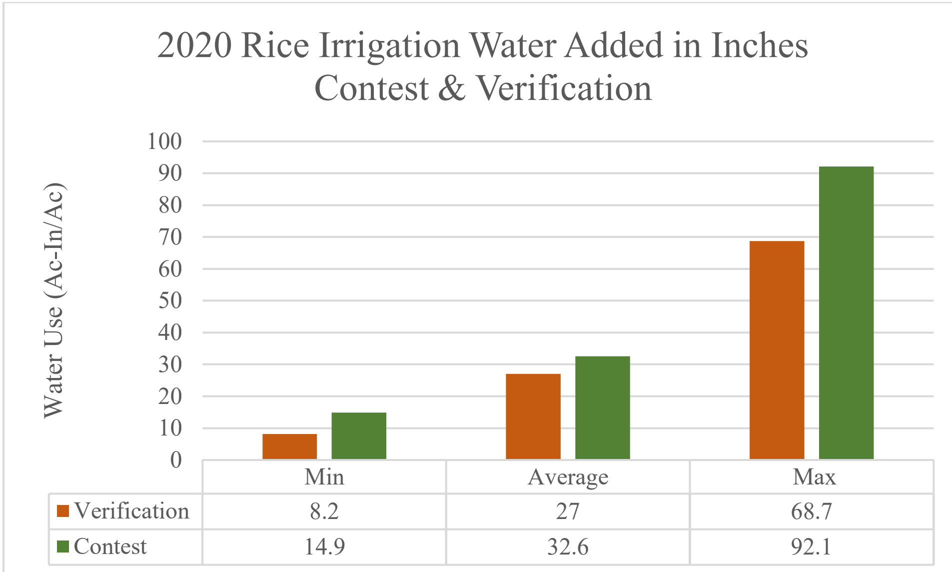


Figure 23. Contest Rice Irrigation Water Use vs Verification Water Use

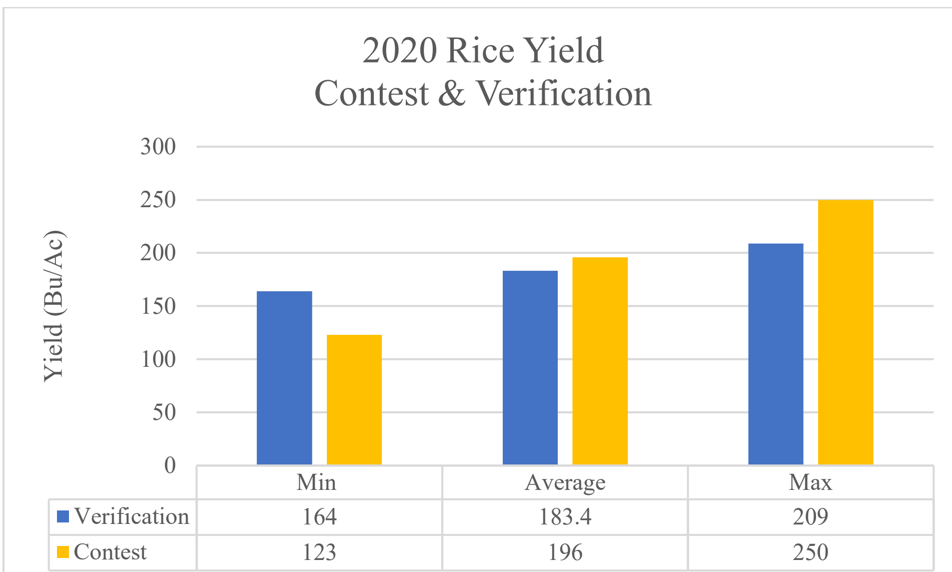


Figure 24. 2020 Contest & Verification Rice Yield

The winning rice field was grown in Mississippi County by Cody Fincher (Figure 25) who produced a strong yield of 240 BPA with a water use efficiency of 8.72 bushels/inch. Cody stated "Going into the University of Arkansas Most Crop per Drop Irrigation Yield Contest, I had the perfect field in mind. The field is 44 acres and is leveled on a half tenth which means it only needs 3 levees to flood irrigate. "I knew going into the contest that I more than likely wouldn't have the highest yield so my goal was to be the most efficient with my water usage and I knew that this field would be a perfect candidate to meet this I criteria. On the first initial pumping I held a shallow flood to get the fertilizer activated without stretching the rice. Once the rice got some height to it I was able to raise the water level by several inches and hold as much water as I possibly could. I let the high end of the field almost crust over before I would turn the well on and this allowed me to go longer in between pumping cycles. I also made sure that I never over pumped and to my knowledge I never lost a drop on the bottom end. I'm a 3rd generation rice and soybean farmer from Dyess, AR. My dad rented me 40 acres right out of high school and with his help I've expanded those acres exponentially over the past several years. I've been very blessed with this business partnership with him and I hope to one day help him as much as he's helped me by being able to apply things such as what I learned from this contest to the farm. It showed me how much we could save on irrigation inputs and will increase profitability on our farm for years to come."

The contest field consisted of a uniform Sharkey Clay. There were 3 paddies in the 40 acre field that is graded at .05 ft per 100 ft. The type of irrigation chosen was the cascade flooding, but it was managed very well. Cody only added water 2 times after he flooded the field.

Figure 25. Cody Fincher With His Father Mark

The second-place winner for the rice division is Seth Tucker of Drew County (Figure 26). This is his first-time producing row rice. His contest field was also a University of Arkansas Rice

Research verification field. He was advised by Ralph Mazzanti. Tucker achieved a yield of 211 BPA and WUE of 6.87 bushels/inch for 2020. Figure 19 Shows Tucker the day of contest harvest. Seth says "Our contest field was on a new landlord and a new field. This was my first year to grow furrow irrigated rice. The field next to it was a Rice Research Verification field and we used Ralph's advice on how to manage row rice. We planted on existing beds. This field is irrigated in 2 sets. The well that was used irrigates 160 acres. The 5-day schedule helped fit rice in the irrigation schedule. We didn't end block initially but did later. We watered on a 5-day schedule unless there was rainfall. I'm a new farmer not from a farm family. I'm married to Samantha with 3 children son (11) daughter (8) and a son (7)."

Figure 26. Seth Tucker (Right) With Max Flemister (Center) and Russ Aaron (Left)

The 3rd place contestant in rice is Clint Boles (Figure 27). He used watermark sensors in his first field. Field selection and sensors made up for his lack of experience with furrow irrigated rice. Clint achieved a yield of 203 BPA and WUE of 6.73 bushels/inch. Clint says "The decision to grow furrow irrigated rice was about not having to build and tear down levees on the heavy clay soil. In the beginning we irrigated once a week and after midseason we irrigated twice a week. Our goal was saving labor and water not making maximum yield at all cost."

Figure 27. Clint Boles (Middle) With his Grandson (Right) and Supervisor visor Rick Wimberly (Left).

Soybean Contest Results

Eighteen fields were entered in the soybean division. The average yield for all soybean contest fields was 79 BPA (33% above the state average yield of 52.9 BPA) (USDA National Agricultural Statistics Service, 2017). The soybean contest average water use efficiency was 3.51 bushels/inch (Table 14). All contest fields were corrected to a 13.5% moisture for the soybean yields considering harvest conditions. None of the producers in this division received an adjustment or penalized dockage for foreign material.

Table 14. 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)*
1	A48XF0	64	3.8	10.9	10.9	14.7	4.37
2	P45A29 LL	76	4.6	13.5	13.4	17.9	4.25
3	AG46X6	99	10.4	13.4	13.4	23.8	4.15
4	P48A60	87	8.7	12.4	12.4	21.1	4.13
5	P47A76LL	72	5.8	11.7	11.7	17.5	4.13
6	Croplan 4641XF	63	4.3	11.3	11.3	15.5	4.08
7	AG46X6	98	10.7	13.4	13.4	24.1	4.07
8	AG48x9	88	12.5	9.8	9.8	22.3	3.95
9	P48A60	106	13.5	13.6	13.6	27.1	3.89
10	Local4565	92	10.1	14.5	14.5	24.6	3.75
11	Local4565	85	20.8	13.4	13.4	34.1	3.56
12	P48A60	81	7.0	15.9	15.9	22.8	3.53
13	Credenz 4770	76	6.3	15.7	15.7	22.0	3.47
14	P48A60	95	12.3	15.9	15.9	28.2	3.36
15	Stine 48eb20	68	16.0	14.6	14.6	30.5	2.24
16	Stine 48eb23	45	8.8	14.9	13.9	22.6	1.98
17	LELAND	53	15.5	13.8	13.8	29.3	1.80
MEAN		**79**	**10.1**	**13.5**	**13.4**	**23.4**	**3.51**

The average irrigation water added to a contest soybean field was 10.1 acre-inches (Figure 28) 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 20.8 inches. The lowest irrigation water applied to a contested field was 3.8 inches to the 1st place soybean contest field.

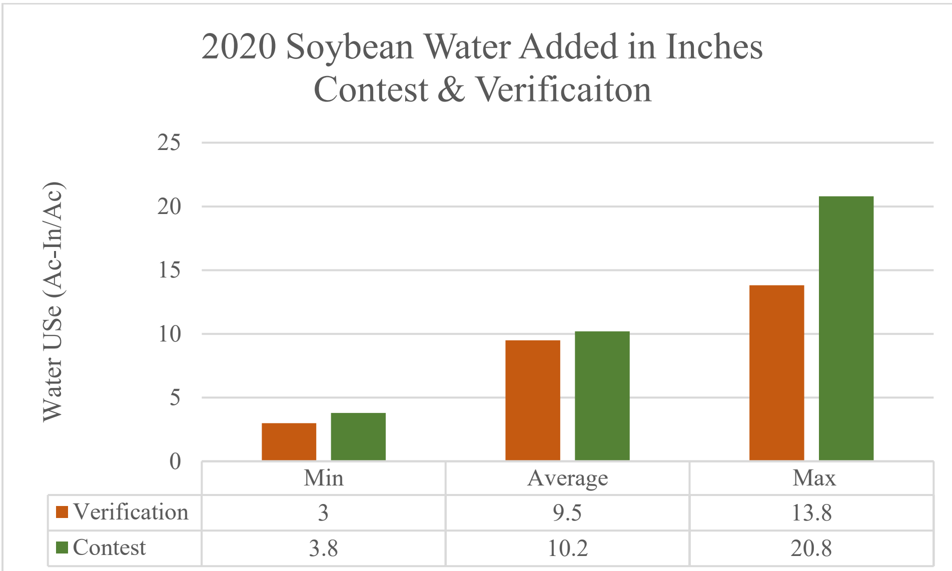


Figure 28. Soybean Water Use (State Average vs. Contest Average)

The maximum yield in the contest was 106 bushels/acre while the contest average was 79 BPA (Figure 29). The lowest yield observed in the contest was 45 BPA which was below the NASS state average yield of 52.9 BPA (USDA National Agricultural Statistics Service, 2017). When comparing the water use and yield between the University of Arkansas Soybean Verification Program, the average irrigation water use was 10.1 ac-in/ac for the contest fields and 9.5 ac-in/ac for verification fields (Figure 28) (University of Arkansas 2019). Average yield for the contest was 79 bushels/acre and 55.2 bushels/acre for verification fields (Figure 29).

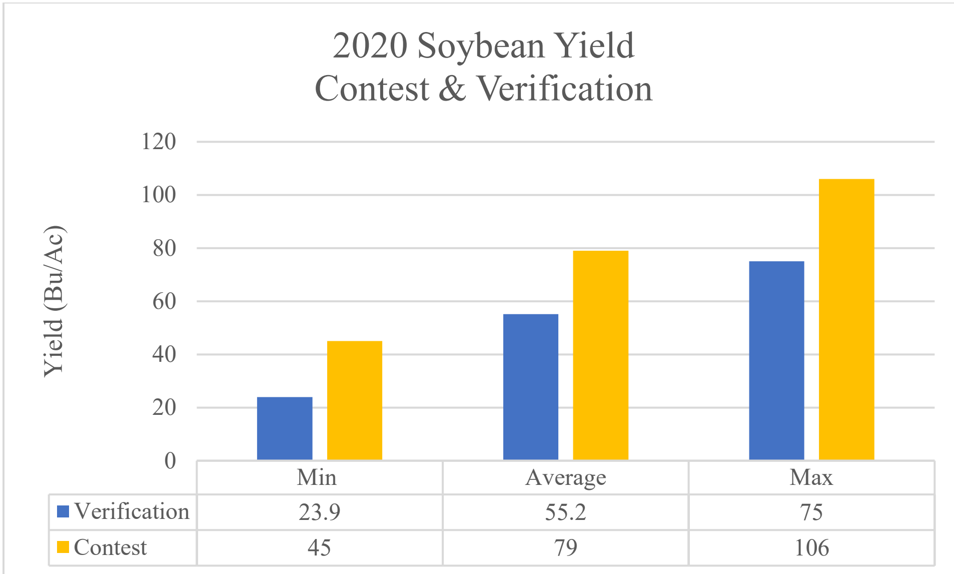


Figure 29. Soybean Yield, Contest Average vs. Verification Average

Figure 30. 1st Place in Soybeans Jeremy Wiedeman with his contest supervisor Stewart Runsick

Clay County producer, Jeremy Wiedeman (Figure 30), was the winner of this division with a yield of 64 BPA and water use efficiency of 4.37 bushels/inch. Jeremy said “My contest field has been no-till for the past 4 years and I believe that helped my WUE the most.” He also had rice stubble that helped keep the ground covered. “Using soil moisture sensors in the contest field allowed me to push irrigation back as far as possible. This reduced the amount of irrigation events while also allowing us to skip a few irrigation events due to rain.". Jeremy says "I started working with my dad when I was 13 years old. My first job on the farm was irrigating. I went to college then came home to follow in my dad and granddads' footsteps. In the contest field we used manual read sensors and the weather to decide when to irrigate. We grow rice, soybeans, wheat, and corn. It's just me my father larry, and four workers and my son Jayden. Irrigating is the first job I gave Jayden. We used the straw from last years' row rice crop as a sort of cover crop. This soil hasn't had any tillage in years except for tillage to clean the furrows for irrigating. I keep notes on everything we do. We also used good variety selection (A48XF0). "

Figure 31. John Allen Mcgraw

Producer John Allen Mcgraw (Figure 31) achieved a yield of 76 BPA and WUE of 4.25 bushels/acre-inch that resulted in achieving the second-place win in the soybean division. John says "I believe the use of soil moisture sensors was the greatest contributor to my high WUE. I set up to compare similar fields, one with sensors and one without. I watered the first field using his normal watering procedure, but only watered the second field when the soil moisture sensors read around 70 centibars. At the end of the season, the field with the soil moisture sensors triggering irrigation received three fewer irrigation events while achieving the same yields. I also used surge valves and cover crops in other fields both of which helped my water use efficiency." Variety selection (P45A29 LL) also played an integral role in the overall water use efficiency.

Figure 32. (Left to Right) Mississippi County Producers, Ryan Sullivan with his Father Mike Mike's Brother Scott his son Gavin.

Ryan and Gavin Sullivan of Sullivan Family Ag (Figure 32), placed third in the soybean division with a yield of 99 BPA and WUE of 4.15 bushels/inch. Sullivan is part of a large Mississippi County farming family. He planted April 9th and used good variety selection (AG46X6) as factors to achieve his WUE. Gavin says "Not all fields are equal, we chose the winning field for the contest because it is efficient to irrigate and has high yield history. Our irrigation strategy in this field was to watch the weather and wait at least 2 days longer to irrigate than the nearby fields."

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. As a testament to the benefits the competition can have for a farmer, the number of participants nearly doubled from 2019 to 2020. The impact and synergisms of utilizing the many water management practice technologies that are available are also quantified through this program. The 2020 Irrigation Yield Contest results were significant and created many success stories. In 2018 there were no contestants who achieved 4 bushels/inch WUE in soybeans, in 2019 there was one 4 bushels/inch contestant and in 2020 there were seven contestants achieved 4 bushels/inch or more. A few of the contest winners this year participated in 2018 with the same crop and saw many improvements using IWM tools. Many of the contest producers stated that adoption of the IWM tools such as watermark sensors and surge valves have a cost and take time in the first year to establish trust and acceptance, but in the end are beneficial at reducing labor and input costs.

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