2018 Arkansas Irrigation Yield Contest Report

"Most Crop Per Drop"

DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

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Executive Summary

The Arkansas Irrigation Yield Contest, “Most Crop per Drop”, is a research and Extension program for the purpose of promoting the adoption of irrigation water management practices. Over 30 producers from fifteen counties throughout the Arkansas Delta region participated in the contest. This was an opportunity for farmers to explore their individual aptitude to reduce energy, water use, and labor. The contest produced notable data results for each grain crop category (corn, rice and soybeans) in terms of water use efficiency (bushels/acre-inch), yield (bushels/acre), and total water use (acre-inches). The winner from each crop category was determined by the contestant with the highest water use efficiency. Each producer used at least one irrigation management tool (computerized hole-selection, multiple inlet rice irrigation, soil moisture sensors or surge irrigation).

Rules specific to an irrigation contest were developed and a website was created to host information and entry and harvest forms. The contest was adapted from traditional yield contests held in other states [2,7,8,10]. Unlike traditional yield contests, the Arkansas Irrigation Contest is awarded to the highest Water Use Efficiency (WUE) achieved. WUE for the purposes of this contest was defined as the yield estimate divided by the total water received by the field. Total water included rain plus irrigation. Rain was estimated from meteorological computer models and irrigation water was measured with portable propeller-style flow meters. Every irrigation flow meter was the same model and were, “sealed” using a specially developed process, before irrigation by UADA. As in traditional yield contests, the yield estimate at harvest was supervised and witnessed by impartial observers (Extension and or NRCS workers). There were three contest categories which included corn, rice, and soybeans. Only first place winners were recognized and each winner received around $18,000 in cash and products.

Mississippi County producer, Jason Bennett, won the corn division with a yield of 227 bushels per acre and water use efficiency of 10.55 bushels per acre-inch out of eight entries. Lonoke County producers, Richard and Matt Morris, won the rice division with a yield of 229 bushels per acre and water use efficiency of 7.80 bushels per acre-inch out of ten entries. Phillips County producer, Michael Taylor, won the soybean division with a yield of 103 bushels per acre and a water use efficiency of 3.92 bushels per acre-inch out of twelve entries.

Each participant received an individualized report card, providing feedback on their WUE and yield performance on their farm compared to the aggregated results from all of 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 nearly fully 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 IWM practices at the county and local level.
- Provide a feedback mechanism for irrigators to benchmark their irrigation management skills.

Figure 1 shows the locations of the contestants. Participation in the contest is entirely voluntary. Generally the distribution of the contestants was well distributed by crop type, however, participation is lacking from the southern part of the state as participation ranged between Arkansas County to Clay County. The winners were well distributed, in that no particular county or location seemed to have an advantage over another. Soil type is known to play a role in soil water storage. Most contestants (Figure 2) were located on silt loam soils (16), However, there were several clay or silty clay soil sites represented (8). Only 1-2 locations were classified as a fine sandy loam.

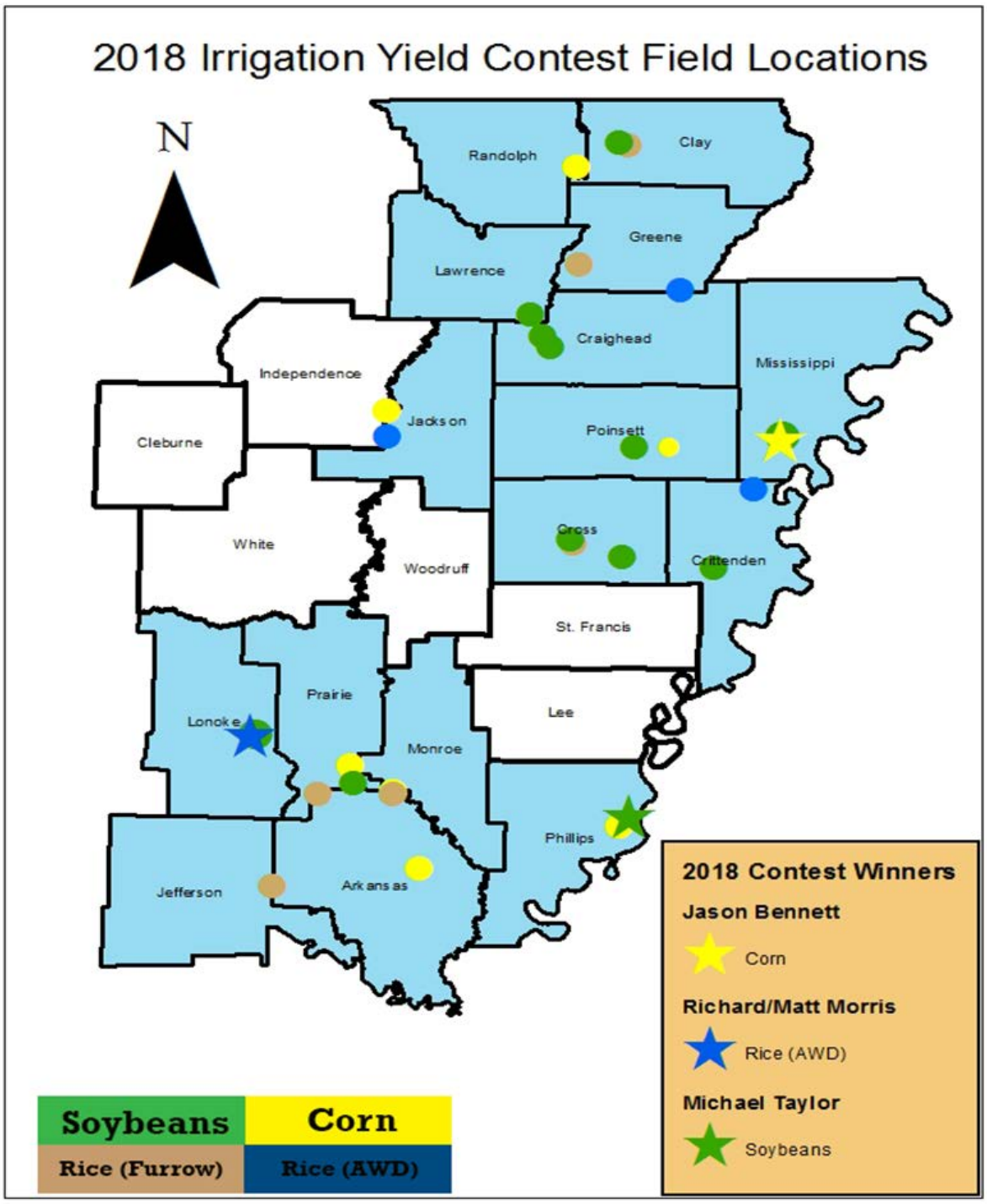


Figure 1.Irrigation contest field locations

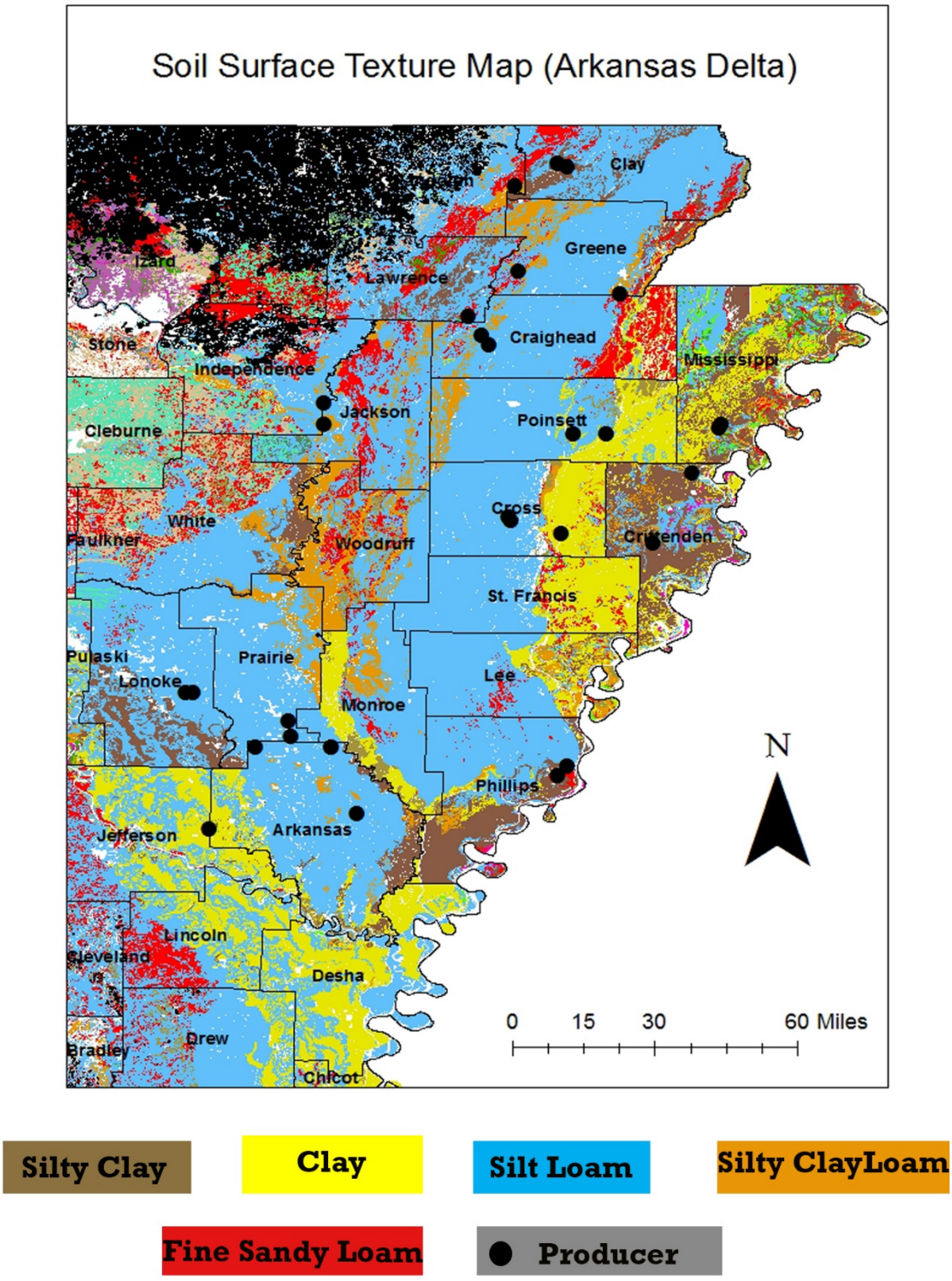


Figure 2. Contestant Soil Texture Map

Materials and Methods

Rules were drafted in the Spring of 2018 and were inspired by long-standing yield contests [2,7,8,10]. Harvest yield estimates are similar 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 must harvest a minimum of three acres, cut top to bottom and utilize a skip pattern. The other requirements include securing a supervisor and a flowmeter to participate in the contest. While UADA staff conducts the contest, a voluntary panel of technical irrigation experts serve as judges to review the final results of the contest and confirm the data and methods. This provides transparency, oversight and third party verification of the contest.

Water Use Efficiency

Water use efficiency (WUE) is defined as the amount of yield produced for a specified amount of water input. Irmak et al. [6] defines Crop Water Use Efficiency as a benchmark water use efficiency where,

$WUE_b = Y_i / (P_e + IR + \Delta SW)$ (Equation 1)

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)

For the irrigation contest, this same equation is used, however 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 most contestants are starting out with a full or nearly full profile. Also estimating this adds more complexity to 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 final 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, only high rainfall events are excluded during the first 30 days after emergence. A high rainfall event was considered a three inch rain since this is the expected amount of a furrow irrigation event. All events in excess of three inches after

30 days after emergence were adjusted to three inches. Even with this adjustment, there were only a few extreme events, and the adjustment did not have any impact on the final result. In the future more work is needed to develop a regionally specific adjustment for effective rainfall. Essentially for this contest, only extreme events are adjusted. Thus the equation 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,

WUE = Y / (P_e + IRR) where, (Equation 2)
WUE = Water Use Efficiency in Bushels per acre-inch
Y = Yield estimate from harvest in bushels per acre
P_e = Effective precipitation in inches
IRR = Irrigation application in inches

Meter Sealing

Irrigations were totalized using 8" and 10" portable propeller mechanical meters manufactured by McCrometer. Each meter was sealed using a standardized meter sealing procedure developed. Meters were sealed to the universal hydrant by using circle lock clamps, serialized wire ties, polypipe tape, stickers, and stamps. The serialized wire ties are tamper proof, cannot be removed except by cutting. Universal hydrants were also sealed to the alfalfa valve using the same serialized wire ties. Lay flat poly pipe was sealed to the meter with specialized waterproof tape. Every other connection made past the meter would also be sealed with tape to ensure a tamper proof connection. Special tamper proof stickers were also used in addition to tape to add an additional layer of security. All other sources of irrigation to that field were also sealed to prevent non-measured irrigation sources from being used in the contest field (Figure 4). Figure 3 shows a typical meter sealing configuration.

Figure 3. Example of Meter Sealing

Figure 4. Example of sealing alfalfa valve in contest field to exclude it from irrigation water contributions

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 be within 5% of the reference meter, else the water use is adjusted according to the reference meter and the contest results adjusted accordingly.

Rainfall Estimation

Farmlogs™ (Ann Arbor, MI) and Climate Corporations Fieldview™ (San Franciso, 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 was 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 two different commercially available computer model predictions.

The precipitation was assessed for each site utilizing two commercial rain prediction services to draw a comparison (Table 1). The two services are Farmlogs™ and Fieldview™ Farmlogs™ and Fieldview™ use a computer algorithm to determine rain intensity correlated from the radar provided by the National Oceanic and Atmospheric Administration (NOAA). This creates a secondary option to substitute for a rain gauge that is not readily accessible to the farmer. A method to collect rainfall was devised that would be as objective and impartial as possible.

Table 1. Rainfall from June 5 to August 31, 2018

Location Number	Location	Rain Bucket	Farmlogs™	FieldView™
1	O'kean	10.95	9.12	11.82
2	ASU Jonesboro	14.09	14.37	14.8
3	UADA Keiser	9.4	10.4	10.58
4	Harrisburg	16.22	12.98	15.41
5	Judd Hill	12.36	10.99	11.45
6	DIAZ	8.26	11.33	9.45
7	Crawfordsville	8.28	9.59	9.72
8	Carlisle	9.08	9.89	7.55
9	Helena airport	8.29	8.62	8.7
10	RREC Stuttgart	8.86	8.5	8.5
11	Gould	13.84	11.77	10.71
12	Mcgehee	14.04	11.75	13.92

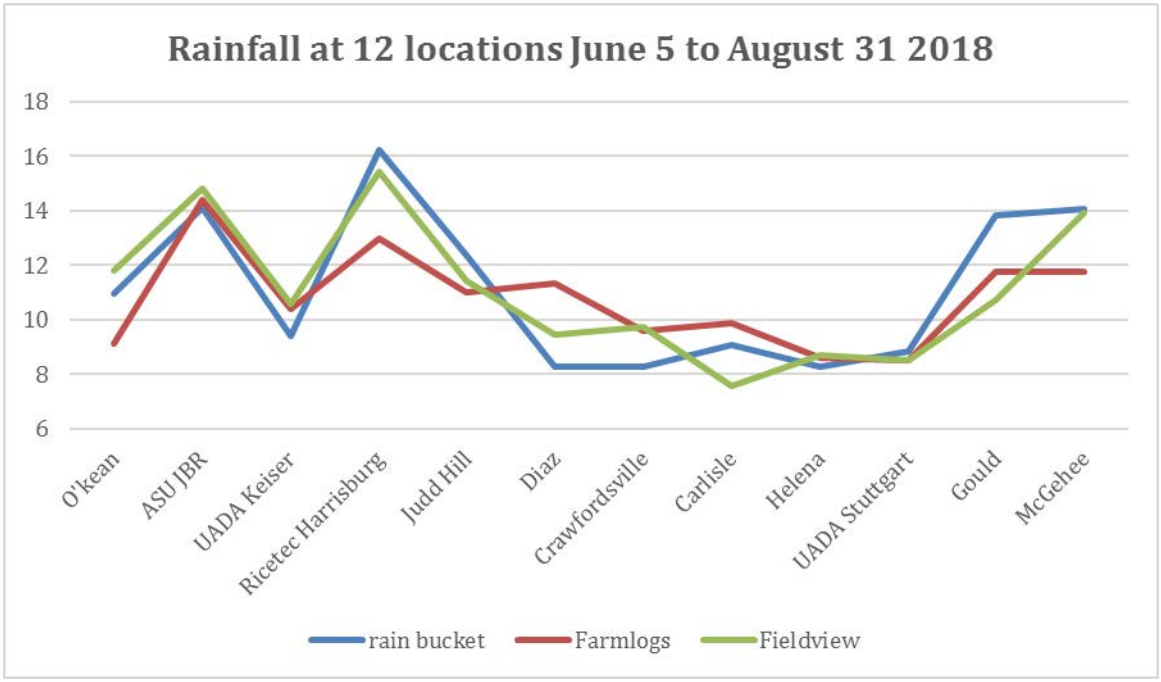


Figure 5. Rainfall was compared between 12 locations

Twelve locations with tipping bucket rain gauges or manual read rain buckets located in the state were used to compare rainfall estimates from the estimation methods to actual measurements from weather stations (Figure 5). Data for a specified period of time was collected for each location (June 5 to August 31) to give a comparable data point for each location and data source.

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. Rainfall is reported for each contest field from emergence to maturity. Information from the contest entry forms about the planting date gave us an emergence date and genotype/cultivar/hybrid grown provided crop maturity.

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 Farmlogs™ rainfall to Fieldview™ rainfall.

The raw data was compared to the rain prediction services, Farmlogs™ and Fieldview™. A one-way Analysis of Variance was done to test if there were numerical differences between rain gage data and the estimates generated from Farmlogs™ and Fieldviews™. The differences between the groups was not significantly different (p=0.93), and the data was found to have equal variances and normality. The lack of difference suggest that using the computer rainfall prediction method is a reliable way to determine rainfall contributions to contest fields. This is a limited dataset and only analyzed for 2018. Additional data will be collected in future years to confirm the reliability and accuracy of this approach to rainfall estimation for the contest.

Table 2. Comparison of Farmlogs™ Rainfall data and Climate Corp Fieldview™ Rainfall data

	No. of Discreet Rain Events	Mean Rain Depth per Event (Inches)	N (12 Locations)
Farmlogs™	11.58	0.9766	139
Fieldview™	24	0.4718	288

The ideal situation in the future is to set an individual rain gauge in each field along with the consistent use of Farmlogs™. While rain gauges may be thought of being more accurate, for the administration of a contest, they were believed to be less reliable and were subject to tampering. Additionally birds and insect interference could play a major role in the results, potentially skewing the results unfairly and placing a considerable burden to maintain rain gauges on the supervisors and contest administrators. Thus, the rainfall estimation methods were considered a more reliable and fair approach to estimate rainfall for the contest. Table 3 shows the total growing season rainfall for each of the contest categories, corn, rice and soybeans.

Table 3. Contest Site Rainfall Amounts

Location	Crop	IRR type	Variety	Relative Maturity	Planting Date	Rainfall Inches
Dewitt	corn	furrow	Dekalb 6208	112	3/23/2018	11.07
Casscoe	corn	furrow	Agrigold 6499 STX	112	4/20/2018	11.78
Slovak	corn	furrow	Agrigold 6499 STX	112	4/13/2018	9.99
Biggers	corn	furrow	DKC 67-44	117	4/13/2018	9.02
Oil Trough	corn	furrow	DK 67-70	117	4/5/2018	12.86

Joiner	corn	furrow	Pioneer 2089	120	4/12/2018	13.05
Helena	corn	furrow	Pioneer 1870	115	4/13/2018	12.58
Payneway	corn	furrow	DK 70-27	120	4/9/2018	12.35
Oil Trough	rice	AWD	Gemini 214 CL	120	4/20/2018	15.32
Gilmore	rice	AWD	XP753	120	5/3/2018	13.29
Carlisle	rice	AWD	XP753	120	5/8/2018	13.40
Corning	rice	furrow	Gemini 214 CL	120	4/9/2018	7.35
Walcott	rice	furrow	XP753	120	4/20/2018	14.64
Casscoe	rice	furrow	XP753	120	5/10/2018	14.24
Wynne	rice	furrow	XP753	120	4/12/2018	15.99
Slovak	rice	furrow	XP753	120	5/5/2018	12.58
Altheimer	rice	furrow	CLXL745	115	5/3/2018	15.09
Oil Trough	rice	furrow	Gemini 214 CL	120	4/20/2018	14.59
Paragould	rice	miri	XP753	120	4/12/2018	13.67
Ulm	soybeans	furrow	P47T36	4.7	5/14/2018	14.09
Crawfordsville	soybeans	furrow	S48-R2X	4.8	5/2/2018	15.97
Joiner	soybeans	furrow	Credenz 4222/dg4597	4.5	5/1/2018	14.09
Helena	soybeans	furrow	Morsoy 47X6	4.7	4/11/2018	15.99
Parkin	soybeans	furrow	Stine 42LH22	4.2	4/15/2018	16.50
Wynne	soybeans	furrow	Asgrow 46CX11	4.7	5/22/2018	14.95
Egypt	soybeans	furrow	Cropland 4775	4.7	5/2/2018	14.94
Cash	soybeans	furrow	Morsoy 47X6	4.7	5/2/2018	17.03
Carlisle	soybeans	furrow	Armor 48D24	4.8	5/16/2018	14.01
Corning	soybeans	furrow	Credenz 5150LL	5.1	5/12/2018	11.58
Bono	soybeans	furrow	Dynagro 48XT56	4.8	5/18/2018	13.17
Payneway	soybeans	furrow	Progeny 4816RX	4.8	4/19/2018	17.59

Harvest Yield Estimate

The yield estimate for the contest is determined by harvesting part of the field with a neutral party observer or supervisor. The yield estimate is determined by harvesting a three acre sample of the contest field. Every yield contest was witnessed or supervised by a third party. Supervisors are meant to exclude anyone with a financial interest in the outcome. In most cases extension agents and or NRCS personnel were present as contest supervisors for harvest. 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 the selected harvest, the combine grain hopper, grain cart, and truck hoppers are to be inspected and be empty. A minimum of three acres are harvested using certified scale weights from a public grain buyer. The supervisor must be present to witness the full and tare weighing of the harvest truck.

There was place on the harvest form to report field location, truck weight, moisture, and foreign material. Moisture percentage and foreign matter must be recorded on the scale ticket. Yield was adjusted to 12% moisture for rice, 13.5% for soybeans and 15% for corn. Foreign matter in excess of 1% was deducted from the yield, as stated on the scale ticket. 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 was generally accomplished by measuring row lengths and width of cut. Some fields were measured using a digital rangefinder. Every field was measured using a measuring wheel. At least three acres of the 30 acres was required to be cut and the area must be rectangular. Passes from the top to bottom of the field were required after turn row removal. Combines harvested one pass, then skipped two passes before harvesting the next pass, until three acres were harvested.

A minimum yield requirement was used to ensure the contest results would be representative of both high water use efficiency and profitable yields. It is well known by irrigation scientists that high Water Use Efficiency (WUE) can be achieved through deficit irrigation. Both are necessary for the contest to be relevant to irrigated agriculture in Arkansas. Originally, the rules required that the yield estimate for the contest to be higher than the county average yield. However, it was decided for all future years, using the data collected in the first year, that arbitrary yields be used of 200 BPA for corn and rice and 60 BPA for soybeans. Thus the contest is challenging, because 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.

2018 Contest Participants & Field Requirements

The 2018 Arkansas Irrigation Yield Contest was conducted on 30 commercial fields across the state. Fifteen counties participated in the program: Arkansas, Clay, Craighead, Crittenden, Cross, Greene, Jackson, Jefferson, Lawrence, Lonoke, Mississippi, Poinsett, Phillips, Prairie, and

Randolph that amassed to 1,587 total acres. Each complete field of 30 or more continuous acres was planted and irrigated. The field may have only one irrigation water source or riser to the field (multiple pumps may supply the field through a single hydrant). Tables 8, 9 and 10 below display the field characteristics and planting information for each of the 30 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 for more than one crop but may not win for more than one crop per year. Winning contestants may not enter for the same crop, once a person wins first place for a crop, they cannot win for that crop again. Unlike other yield contests, that have multiple categories and production systems represented, the irrigation contest is limited, thus 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.

Table 4. Contest Corn Field Characteristics

Producer	Previous Crop	Planting Population	Energy Source	Water Source	Flow Rate (GPM)	Row Spacing	Variety or Hybrid	Acres
1	Soybeans	36,000	Electric	Surface	Unknown	Twin Rows 10" (40" beds)	Dekalb 6208	30
2	Soybeans	36,000	Diesel/Electric	Surface	1,200	30 in	AgriGold 6499 ST	36.5
3	Soybeans	34,000	Diesel	Surface	1,200	30 in	AgriGold 6499 ST	83
4	Peanuts	35,000	Diesel	Well	1,100	30 in	DKC 6744	36.39
5	Soybeans	38,000	Diesel	Well	1,400	30 in	67 - 70	46.9
6	Cotton	36,000	Diesel	Well	800	38 in	Pioneer 2089	38.8
7	Soybeans	35,000	Diesel	Well	1,800	30 in	Pioneer 1870	33
8	Soybeans	34,808	Diesel	Well	1,200	38 in	Dekalb 70 - 27	33

Table 5. Rice Contest Field Characteristics

Producer	Irrigation Method	Previous Crop	Planting Population	Energy Source	Water Source	Flow Rate (GPM)	Row Spacing	Acres
1	AWD	Soybeans	22.5 lbs/acre	Electric	Surface Water	1,200	7.5 in	58.8
2	AWD	Soybeans	20 lbs/acre	Diesel	Ground Well	1,300	10 in	51
3	Row	Soybeans		Electric	Surface Water	1,000	***	40.9
4	Row	soybeans	24 lbs/acre	Diesel/Electric	Ground Well/Surface Water	1,100	7.5 in	34
5	AWD	Soybeans	22 lbs/acre	Electric	Ground Well	2,000	7.5 in	37
6	Row	Soybeans	25 lbs/acre	Diesel	Ground Well	1,500	7.5 in	31.5
7	Row	Soybeans	25 lbs/acre	Electric	Ground Well	1,100	7.5 in	43.5
8	AWD	Soybeans	23.7 lbs/acre	Electric	Ground Well	2,000	6 in	48
9	Row	Soybeans	22.5 lbs/acre	Electric	Ground Well	1,300	7.5 in	***
10	Row	Rice	22 lbs/acre	Electric	Ground Well	1,400	76 in beds	37.9

Table 6. Contest Soybean Field Characteristics

Producer	Previous Crop	Planting Population	Energy Source	Water Source	Flow Rate (GPM)	Row Spacing	Variety or Hybrid	Acres
1	Soybeans	128,000	Electric	Surface/Ground	1,000	30 in	Pioneer 47T36	36
2	Rice	145,000	Diesel	Well	2,200	38 in	S48 - R2X	121
3	Corn	140,000	Diesel	Well	1,700	38 in	Credenz 4222/DG4597	160
4	Corn	130,000	Diesel	Well	3,500	15 in	Morsoy 47x6	64
5	Rice	125,000	Diesel	Well	2,500	7.5 in	Stine 42LH22	30

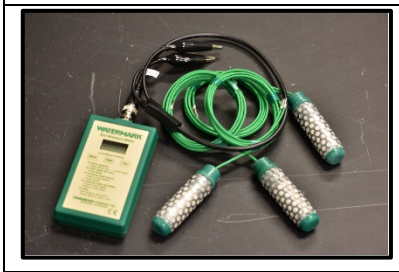
6	Rice	126,000	Diesel	Well	Unknown	7.5 in	Asgrow 46CX11	59
7	Rice	160,000	Diesel	Well	1,900	30 in	Cropland 4775	33
8	Soybeans	128,000	Electric	Well	Unknown	Twin Row 38"	Morsoy 47X6	65
9	Corn	150,000	Electric	Well	1,200	7.5 in	Armor 48D24	37
10	Corn	153,000	Diesel	Well	2,000	30 in	Credenz 5150 LL	40
11	Soybeans	136,000	Electric	Well	Unknown	30 in	Dynagro 48XT56	37
12	Cotton	127,629	Diesel	Well	2,000	38 in	Progeny 4816RX	78

Description of Awards

Participants were awarded for highest water use efficiency in each crop category (Corn, Soybean, & Rice). A total $18,185 is given to each of the three winners that contain various cash prizes and products from the sponsors who generously contributed to the contest. Table 7 highlights the value amounts for each crop division. For unknown reasons, Triad aka DamGates did not supply the promised 10" surge valve for each of the 2018 winners. Additional support for the program was provided by Mccrometer, through a discount program ($10,000) to provide meters for the contest in addition to providing meters to the winners.

Table 7. Prizes Awarded

Rice Division	Corn Division	Soybean Division
$10,000 seed tote credit sponsored by RiceTec	**$10,000** cash sponsored by the Arkansas Corn and Grain Sorghum Promotion Board	**$10,000** cash sponsored by the Arkansas Soybean Promotion Board
$1,333 in additional cash from Irrometer and Delta Plastics		

First Place Winners of the Corn, Rice and Soybean Division Prizes	
	Irrometer manual reader and three watermark sensors $325

	10” Mccrometer portable flow meter with a FS-100 Flow Straightener $2,271
	P & R Surge Systems, Inc. Valve and STAR controller $3,256
	Trellis Base and Sensor Station $1,000

Awards were presented to the winners at the Arkansas Soil and Water Conversation Conference on January 30, 2019. Pictures were taken with the sponsors during the conference and put out through social media. McCrometer presented the portable meters to the winners (Figure 6). Gary Sitzer represented the Arkansas Soybean Promotion Board and presented the cash award to Michael Taylor (Figure 7). Tommy Young of the Arkansas Corn and Grain Sorghum Promotion Board presented the cash award to Jason Bennett (Figure 8). Ricetec representative presented the seed tote to the Morris Family at the Delta States Irrigation Conference (Figure 9). While Henry Martinez of P and R Surge was not able to be present, he made sure the winners were able to accept their valves at the Arkansas Soil and Water conference (Figure 10). Matt Lindsey of Delta Plastics presented the award checks to the winners, shown is Michael Taylor (Figure 11). Steve Perkins presented the winners with their cash award and sensor equipment, shown is Jason Bennett (Figure 12). Finally, Trellis presented their soil moisture base and sensor station to the

winners (Figure 13). A formal presentation was made at the Arkansas Soil and Water Conference to recognize the winners and their achievement. Bennett and Morris also presented at a special panel session at the Delta States Irrigation Conference in Baton Rouge on January 31 and February 1, 2019.

Figure 6. Mccrometer Portable Meter Presentation: Richard Morris, Hugh Ivey, and the Matthew Morris Family.

Figure 7. Arkansas Soybean Promotion Board Check Presentation: Gary Sitzer and Michael Taylor

Figure 8. Arkansas Corn and Grain Sorghum Board Cash Award Presentation: Tommy Young and Jason Bennett

Figure 9. Ricetec Seed Tote Presentation to the Morris Family

Figure 10. P and R Surge Presentation: Jason Bennett (Henry Martinez not present)

Figure 11. Delta Plastics Presentation: Michael Taylor and Matt Lindsey

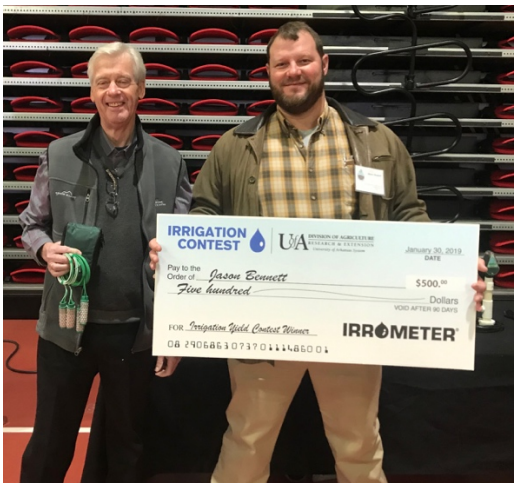


Figure 12. Irrometer Presentation: Steve Perkins and Jason Bennett

Figure 13. Trellis Base and Soil Moisture Sensor Presentation: Richard Morris, Erika Morris, Matthew Morris and son, Mary Blomgren, Jason Bennett, Michael Taylor, and Liz Buchen

Irrigation Water Management Tools

Contestants are asked when they enter their field in the contest about Irrigation Water Management IWM) tools they use on the contest field. Nearly all of the contestants used Computerized Hole Selection (Pipe Planner or PHAUCET) during the 2018 growing season in their contest fields (Figure 14). About half of the contestants used surge irrigation and 54.5% used soil moisture sensors in their contest fields. Figure 15 reports the average Water Use Efficiency for each crop category in the contest for comparison to the winners WUE.

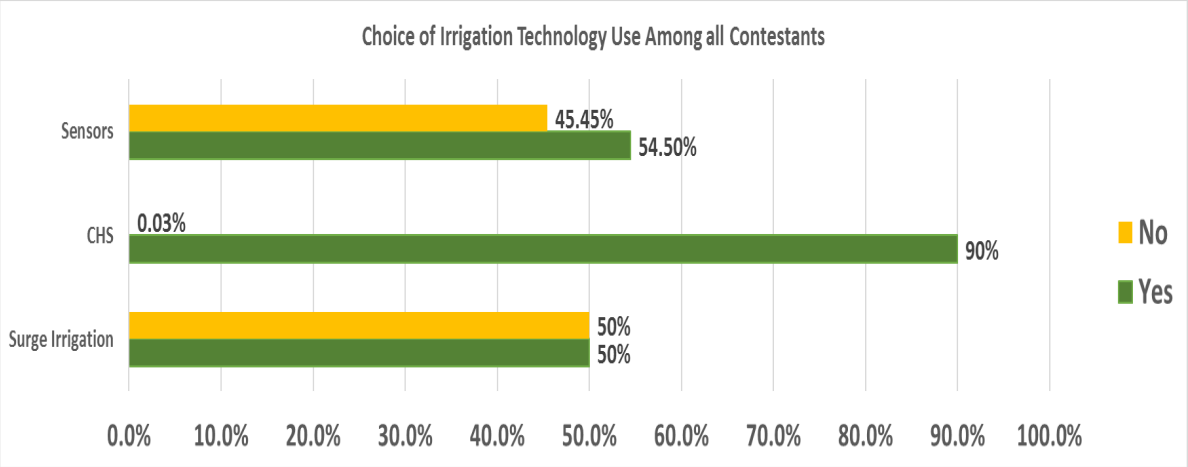


Figure 14. Contest Use of Irrigation Water Management BMPs

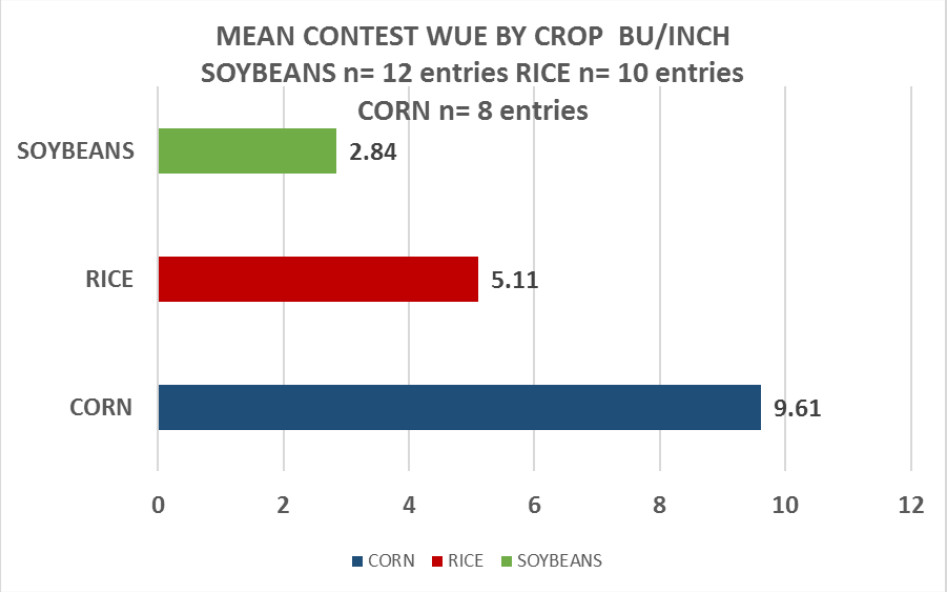


Figure 15. Water Use Efficiency by Crop Type

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 harvest forms and the WUE was determined. Contestants were ranked from high to low. The winning meters were checked against a reference meter at RREC to confirm accuracy. The winning contestant meters were all within 5% of the reference meter. The contest results were presented to a panel of three judges, to review the technical methods used to determine the rankings. The judge panel reviewed the rankings and made the final decision on the winners.

At the time of each individual harvest, at least one supervisor was on field site where each of the equipment was inspected. Yield was determined by harvesting at least 3 acres of the field from top to bottom. Grain yields were taken from the total weights harvested from the contest areas. These weights were measured on certified scales at commercial grain buyers. Samples from harvested area were graded by commercial graders and deductions were made from those samples. Moisture was corrected back to normalized moisture values for each crop. Grain yields were adjusted to account for moisture weight. Water use was calculated by metered irrigation and rainfall during crop growth.

Table 8.Corn Irrigation Contest Result

	Yield (Bushels per Acre)	Irrigation (acre - inches applied)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels per Inch)
Grower 1	212	***	12.6	12.6	***	***
Grower 2	183.2	***	12.9	12.9	***	***
Grower 3	226.9	8.4	13.7	13.1	21.5	10.55
Grower 4	218.4	10.8	10	10	20.8	10.52
Grower 5	210.8	11.3	9	9	20.3	10.38
Grower 6	216.8	12	14.5	11.1	23.1	9.38
Grower 7	264.9	16.9	12.4	12.4	29.2	9.06
Grower 8	160	13.72	11.78	11.78	25.5	6.27
Mean	219	10	12.1	11.6	21.6	9.98

*** Removed from contest or disqualified.

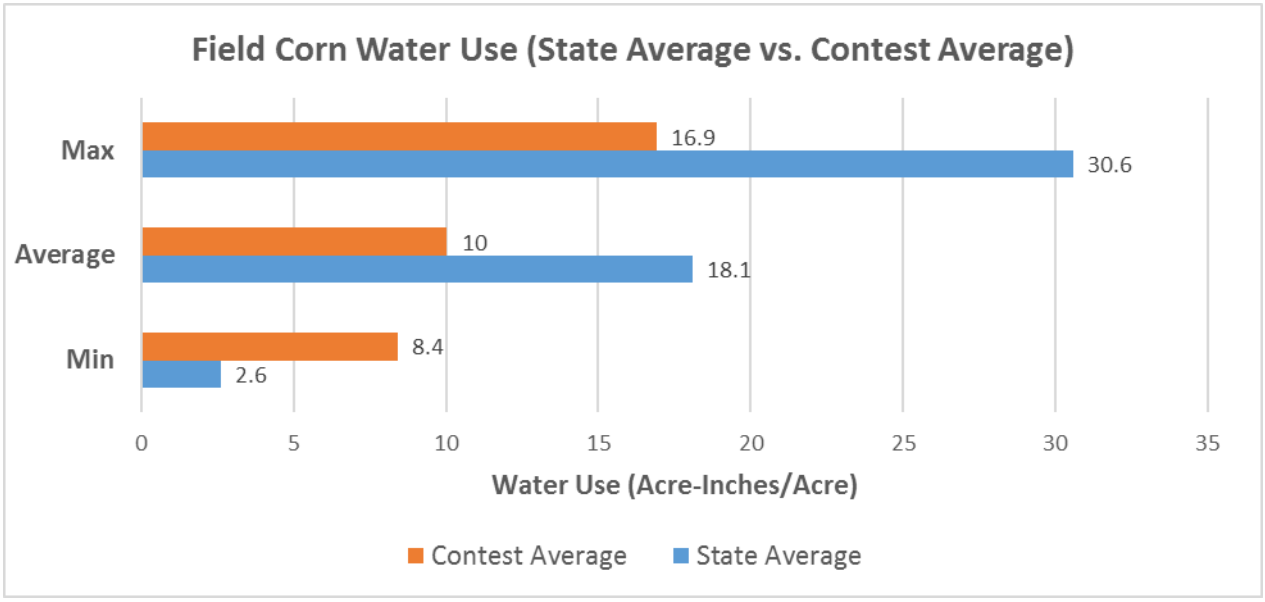


Figure 16. Contest Average Water Use vs State Averages

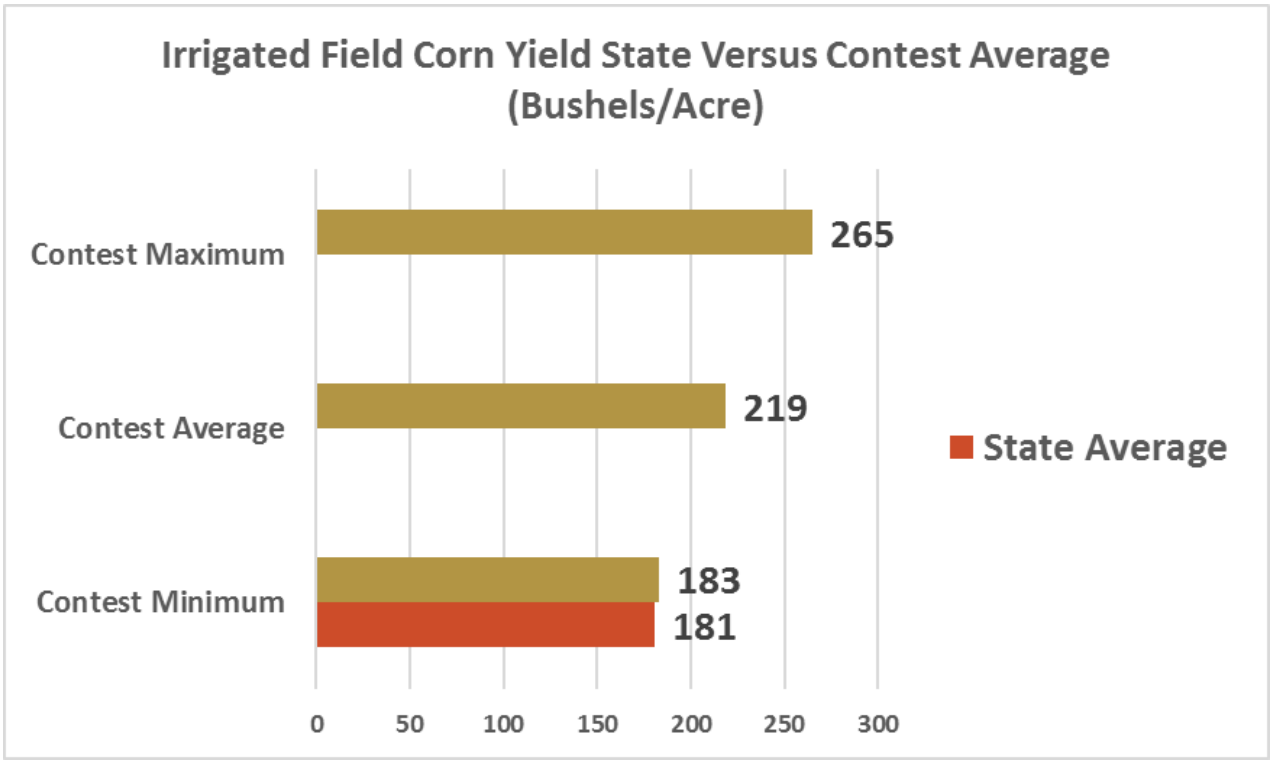


Figure 17. Corn Yield of the Contest vs State Average Corn Yields

Overall eight corn fields were entered into the contest. The entries outperformed the state average for corn yield with conservative water use (Figure 17). The average yield of corn grown for the contest was 219 BPA and the average water use efficiency of corn grown for the contest was 9.98 bushels per acre-inch.

This average yield was 12% higher than the state average for 2018 of 181 BPA [12]. Corn yield was corrected to 15.5% moisture for every field as per the contest rules. None of the fields had an FM grade above 1 to require dockage/adjustment.

The highest yielding corn field was in Poinsett County with a yield of 265 BPA. The Jackson County field that produced the lowest yield of 183 BPA but this contestant withdrew due to irrigation well failure. The water use efficiency ranged from a high of 10.55 bushels per acre-inch to a low of 9.05 bushels per acre-inch. The average irrigation water added to corn contest fields was 10 inches. The highest irrigation water added to a corn contest field was 16.9 inches and the lowest irrigation water added was the winner (Jason Bennett) with 8.4 acre-inches. Figure 16. shows a significant change in corn irrigation use most notably between the contest and state maximum, average, and minimum irrigation water use reported in the 2014 Arkansas Water Plan [3].

Bennett credits the use of soil water moisture sensors (Irrometer Watermark and AgSense Aquatrac), the Arkansas Watermark mobile app, computerized-hole selection (Pipe Planner) and P & R surge valves to steer toward great irrigation scheduling.

Figure 18. Jason Bennet

"*I think that technology today is changing so rapidly that we have to adapt or be left behind; not to keep up with the neighbors but it helps our farms become more efficient and profitable. Pipe planner, surge valves and soil moisture sensors are only a few pieces of the puzzle. As a farmer, I have the responsibility to take care of the land, environment and its resources to the best of my God given abilities*" Bennet said (Figure 18).

Bennett participates in NRCS Irrigation Water Management EQIP programs to receive grant money to improve on-farm profit. The field has diverse soil types specifically ranging from Jeanrette silt loam to Forrestdale, Sharkey and Tunica silty clay loam.

Rice

The Rice Irrigation Contest produced a broad range of results in terms water use between the producers. Among the overall rice fields, four of the rice fields practiced multiple inlet/alternate wetting & drying irrigation that produced an average yield of 223 BPA. Six of the rice fields practiced furrow irrigation that produced an average yield of 202 BPA. All rice contest fields planted RiceTec hybrids seed as shown in Table 9**.**

Six fields were planted with RT XP753, three fields were planted with RT 7311 Clearfield and one field was planted with RT CLXL745. The winning rice field was grown in Lonoke County by Richard Morris and his son Matt and yielded 229 BPA with a water use efficiency of 7.80 bushels per acre-inch. The average rice yield in the rice contest was 209 BPA and the average rice water use efficiency being 5.25 bushels per acre inch. The yield average for the rice contest

was 20% higher than the state average rice yield for 2018 (167 BPA) [13]. Figure 19 shows there is nearly a 5 inch difference in rice irrigation use between contest and state averages. The state minimum, maximum and average values for irrigated water use by crop type as reported from water user reports are used as a metric to compare the contest results [3]. For reference, the long term average irrigation water use for rice reported by [4] is 32 ac-in/ac for contour and precision graded rice and 19 ac-in/ac for zero grade.

Table 9. Rice Yield and Water Use Efficiency for Contest Fields

	Irrigation Method	Yield (Bushels per Acre)	Irrigation (acre - inches applied)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels per Inch)
Grower 1	AWD	229	16	14	13.4	29.4	7.8
Grower 2	Row	194	18.9	13.5	12.6	28.5	6.81
Grower 3	AWD	221.1	20.3	13.3	12.4	32.7	6.76
Grower 4	Row	227.4	26.2	14.2	14.2	40.4	5.63
Grower 5	AWD	218.8	25.4	15.3	14.6	40	5.47
Grower 6	Row	202.1	32.6	7.4	7.4	39.9	5.06
Grower 7	Row	266.6	47.9	16.6	16	63.8	4.18
Grower 8	AWD	223.1	39.8	16.3	13.7	53.5	4.17
Grower 9	Row	192.6	36.7	17.7	14.6	51.3	3.75
Grower 10	Row	131.9	31.4	15.1	14.5	45.8	2.88
Mean		210.7	29.2	14.3	13.3	42.5	5.25

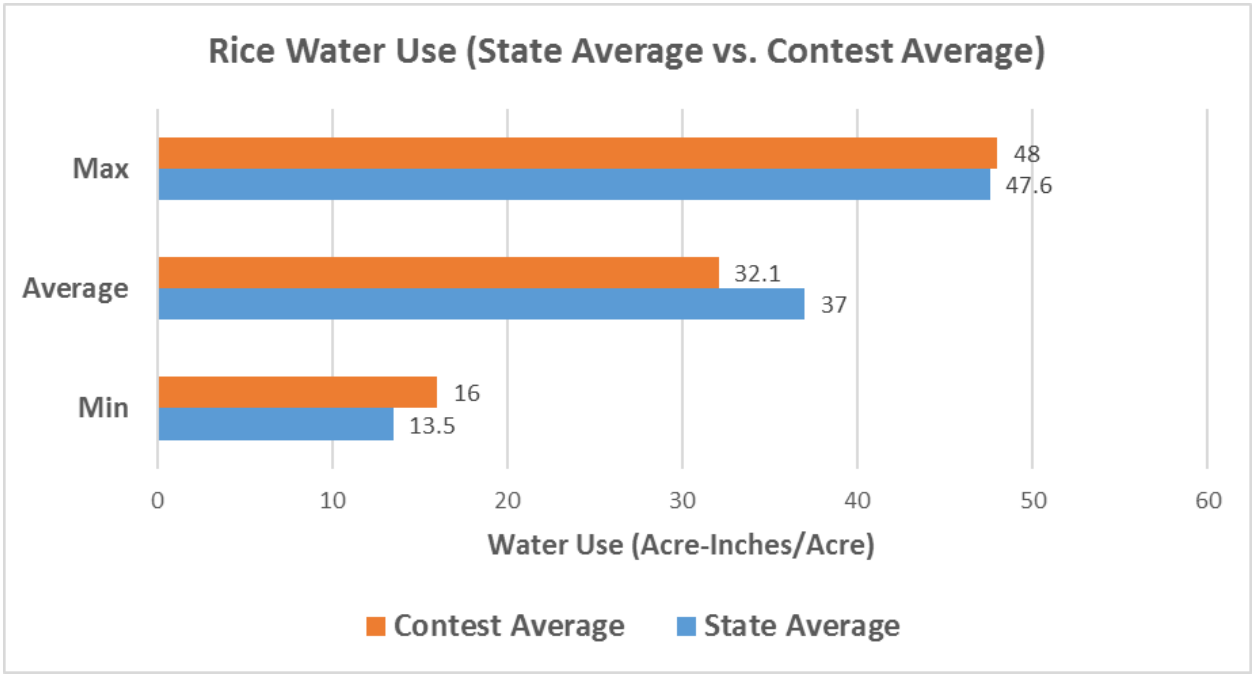


Figure 19. Rice Water Use vs State Average

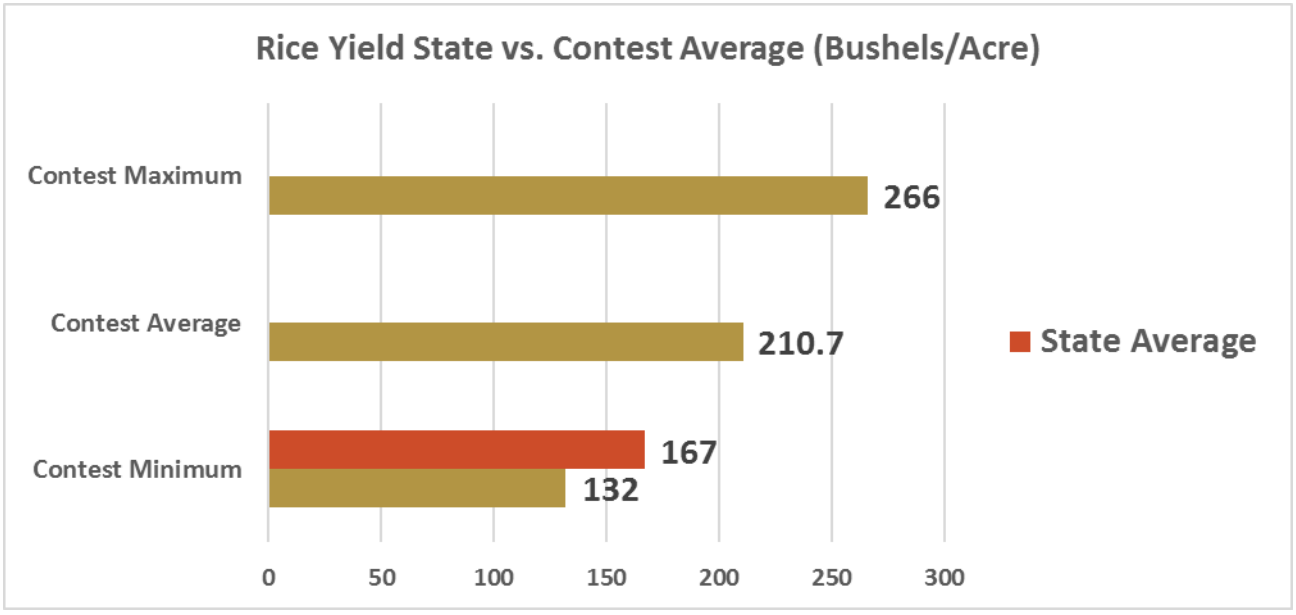


Figure 20. Contest Average yield of AWD flooded Rice versus Furrow Irrigated Rice

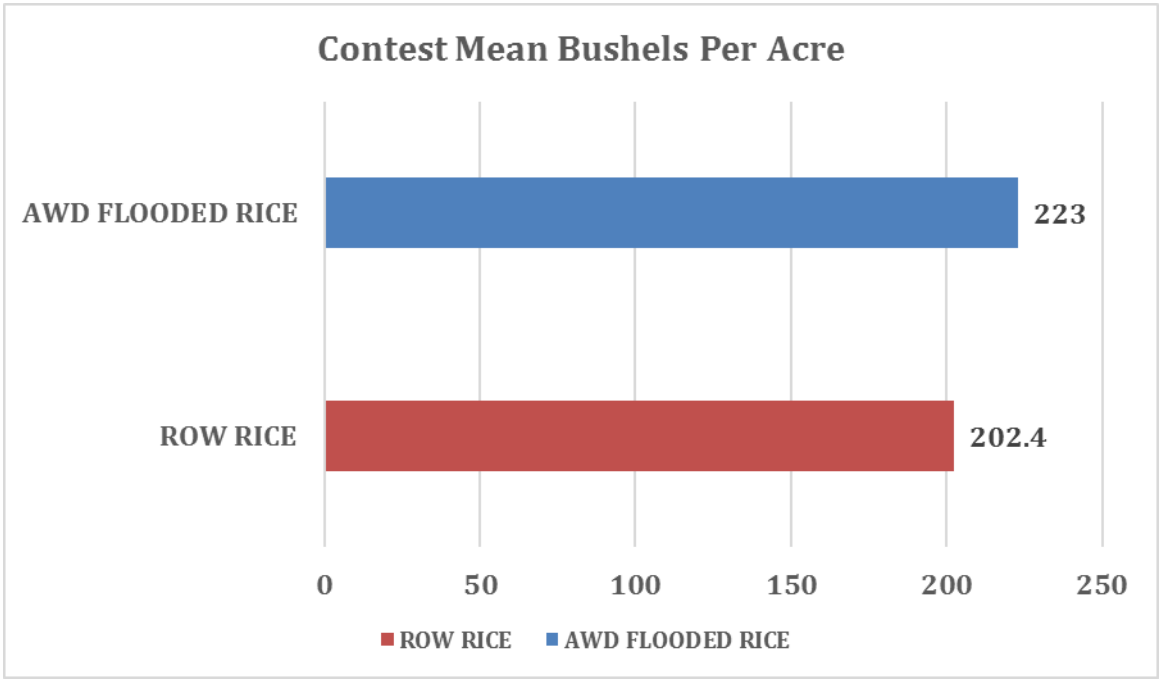


Figure 21. Yield (BPA) of AWD versus Furrow Irrigated Rice

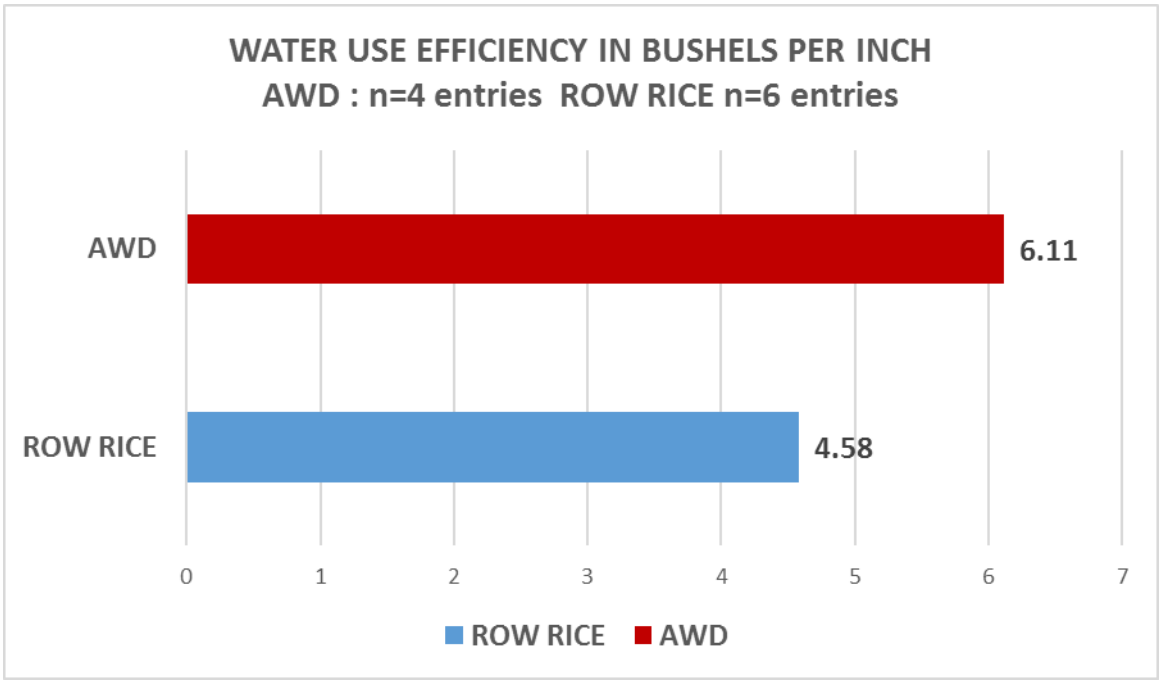


Figure 22. Rice Water Use Efficiency of AWD versus Furrow Irrigated Rice

The average dry bushels for all rice fields were corrected to 12% moisture. Yields in the rice contest ranged from a high of 266 BPA (row rice) to a low of 132 BPA (row rice). The average irrigation water added for all contest rice fields was 32.1 inches. The highest irrigation water added to a contest rice field was 48 inches and the lowest amount of irrigation water added to a contest rice field was 16 acre-inches by the winner.

The contest allowed for a comparison of furrow irrigated rice to AWD rice since six of the entries were furrow irrigated (row) and four were AWD. When the irrigation systems were averaged, the flooded rice entries (6.1 bushels per acre-inch, n=4) were more efficient than furrow irrigated rice entries (n=6) at 4.6 bushels per acre-inch. There was a 7 BPA difference between AWD and furrow irrigated rice yields, when excluding one low furrow entry. This entry had an agronomic problem that impacted the yield, so for the purpose of this analysis that data was excluded. There was no significant difference in yield between AWD and furrow irrigated rice entries (p=0.31). Also when comparing the water use between AWD and furrow irrigated rice there was no difference between these two production methods (p=0.33), although numerically furrow rice used 4-7 more inches of water than AWD. When total water use is compared (rain plus irrigation), this difference decreases to 2-6 inches and is even less significant (p=0.43). Thus there does not appear to be any advantage between the production systems in the limited data set from this dataset.

Figure 23. Chris Henry, Richard Morris, Matthew Morris and Keith Perkins

The winners of the rice contest, Richard and Matt Morris (Figure 23) have a rich history of irrigated rice farming since 1892 have used the multiple inlet irrigation/alternate wetting and drying method to achieve the water use efficiency presented. The contest field was the first commercial rice field in Arkansas. Several technologies were used first-hand including: University of Arkansas "Rice Irrigation" mobile app, a Davis Enviro-monitor Weather Station and an Unmanned Aerial Vehicle for collected satellite imagery. Two on-farm surface reservoirs are used along with a tailwater recovery system to collect the runoff and depend less on the groundwater in the Carlisle, Arkansas area. The field consists of a uniform Dewitt or Stuttgart silt loam.

"*Using Multiple Inlet Rice Irrigation (MIRI) paired with Alternate Wetting and Drying (AWD), I significantly decreased my overall water usage by as much 50%. This is a huge conservation practice when I think about preserving natural resources for my kids and grandkids*", Matthew Morris said were the key lessons gained from the contest.

Soybean

Twelve fields were entered in the soybean division. Phillips County producer, Michael Taylor, was the winner of this division with a yield of 103 BPA and water use efficiency of 3.92 bushels per acre-inch (Table 10). The average yield for all soybean contest fields was 72 BPA (26% above the 2017 state average yield of 52.9 BPA) [11] and the soybean contest average water use efficiency was 2.68 bushels per acre-inch. The USDA National Agricultural Statistics Service has not individually reported 2018 yields between irrigated and non-irrigated soybeans at this

time. All contest fields were corrected to a 13% moisture for the soybean yields considering the out-of-normal wet 2018 harvest conditions. None of the producers in this division received an adjustment or penalized dockage for foreign material.

Table 10. Soybeans yield and Water Use Efficiency

	Yield (Bushels per Acre)	Irrigation (applied acre-inches)	Rain (inches) (unadjusted)	Rain (inches) (adjusted)	Total Water Use (inches)	Water Use Efficiency (Bushels per Inch)
Grower 1	103	10.3	16	16	26.3	3.92
Grower 2	72.4	8	16.5	13.4	21.4	3.38
Grower 3	64	7.7	14	11.6	19.3	3.32
Grower 4	84.9	9.9	18.5	17.6	27.5	3.09
Grower 5	85.3	12.4	18.2	16	28.4	3.01
Grower 6	58.8	4.9	16.5	15	19.8	2.97
Grower 7	64.9	8.9	15.1	14.9	23.9	2.72
Grower 8	53.1	5.6	14.4	14.1	19.7	2.7
Grower 9	65.5	10.5	15.6	14.1	24.6	2.66
Grower 10	72.8	12.6	17	17	29.6	2.46
Grower 11	67.6	15.3	14.6	14	29.3	2.31
Grower 12	68.6	17.4	13.6	13.2	30.6	2.24
Mean	71	10.3	15.8	14.7	25	2.91

The average irrigation water added to contest soybean fields was 10.3 acre-inches (Figure 24) compared to the state average soybean water use of 16.3 acre-inches [3]. The highest irrigation water use by a contested soybean field was Matt Morris with 15.3 inches. The lowest irrigation water added to a contested field was 4.9 acre-inches to the soybean contest.

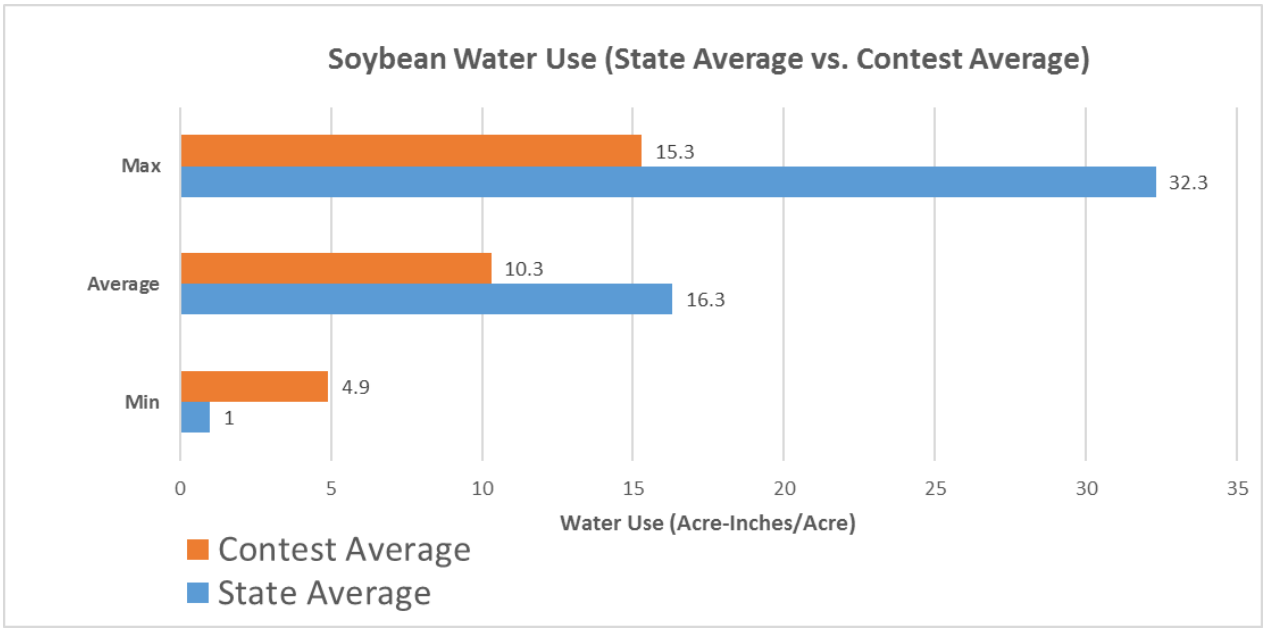


Figure 24. Soybean Water Use (State Average vs. Contest Average)

The maximum yield in the contest was 103 bushels per acre while the contest average was 71 BPA (Figure 25). The lowest yield observed in the contest was 53.1 BPA was very near the state average yield of 52.9 BPA [11].

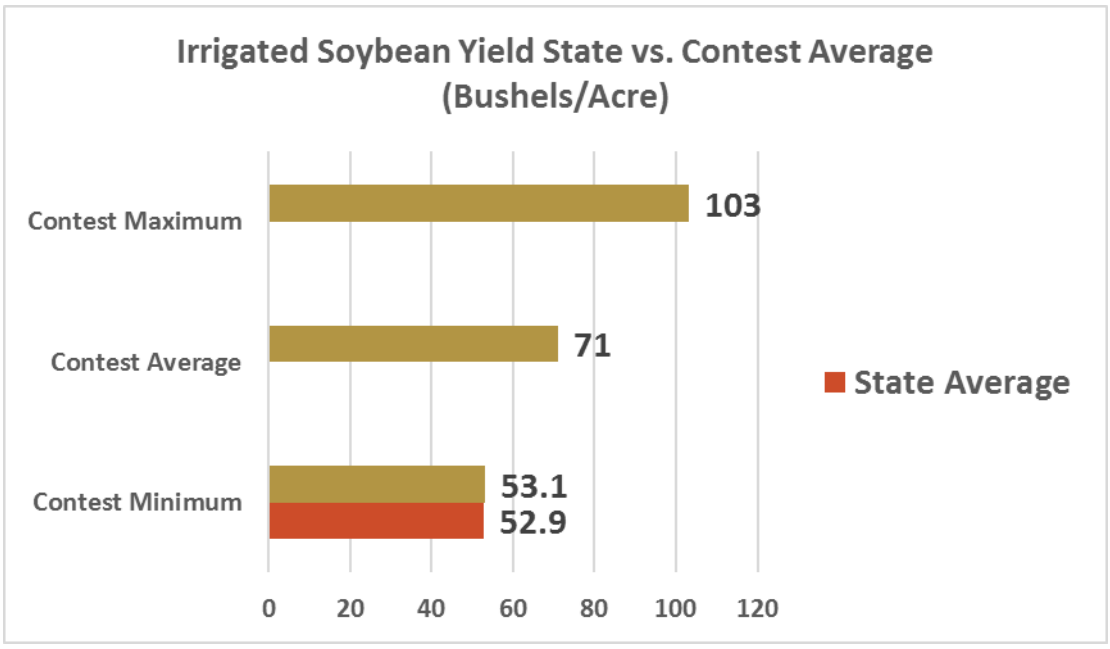


Figure 25. Soybean Yield State vs. Contest Average

Figure 26. Michael Taylor Soybean Winner

The contest winner, Michael Taylor currently uses computerized-hole selection (Pipe Planner), cover crops, and variety selection as part of his conservation efforts and profitability on the farm. Previously Taylor's primary irrigation strategy was the old "seat of the pants" method as he describes it but looks past that now after seeing beneficial yield results from his contest field.

"*We need to manage our water better*," Taylor said in efforts to promote water conservation not only for his farm but the neighboring farms as well.

Taylor's field is located southeast of Helena in Phillips County where the soil classified as a silt loam soil. Cover crops were used on this field as a no-tillage conservation practice. Cereal rye, radish and black oats were used in the fall planted cover crop mix.

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 contest also provides real water use efficiency data that can be used to protect the long term profitability of the region. The impact and synergisms of utilizing the many water management practice technologies that are available are also quantified through this program.

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Thank you to all the sponsors!

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