DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

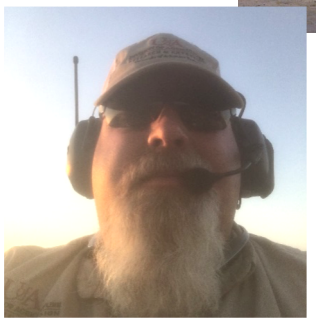
High Yielding Soybean Production: Perspective from a Mid-south Agronomist

Jeremy Ross, PhD

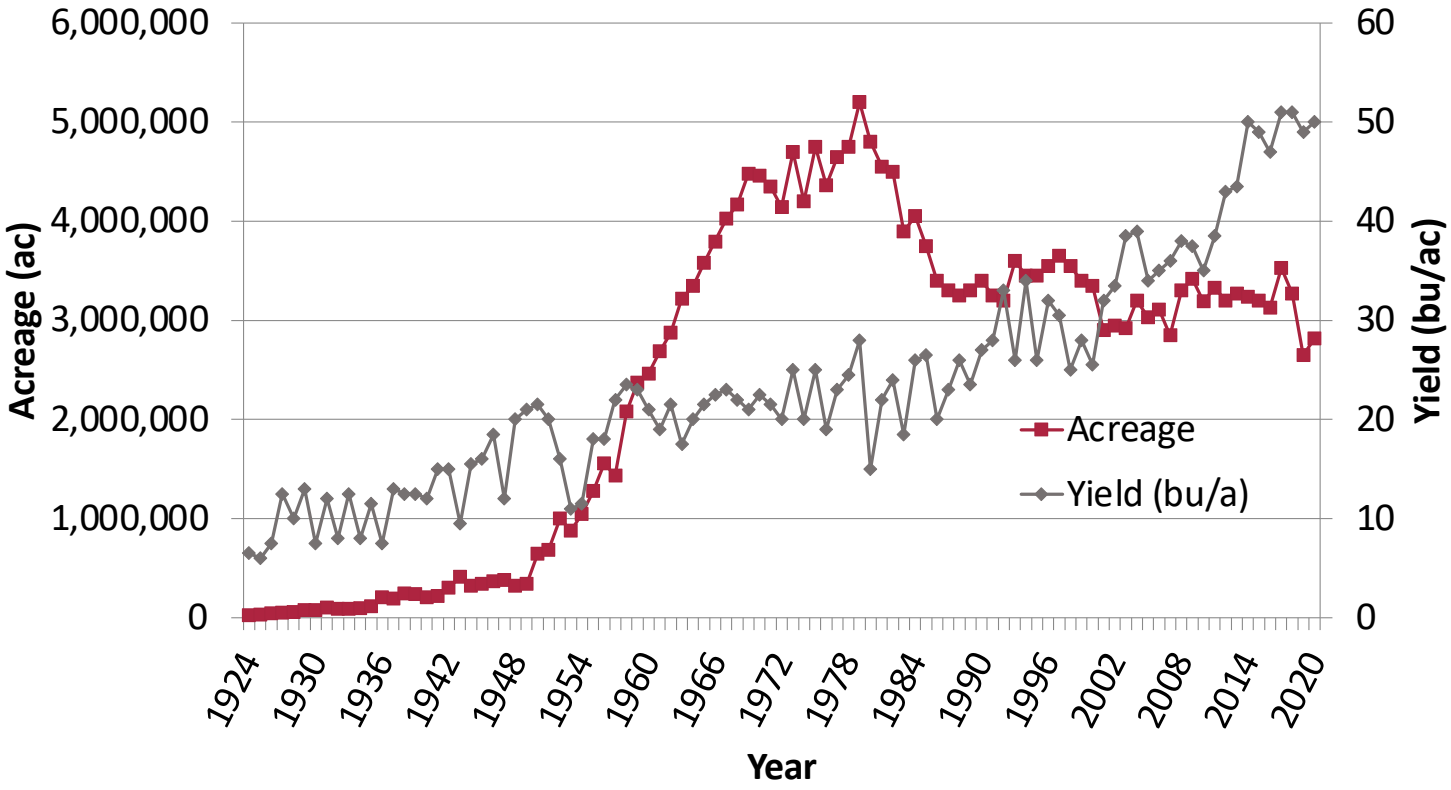
Extension Agronomist – Soybean/Professor

What do I do?

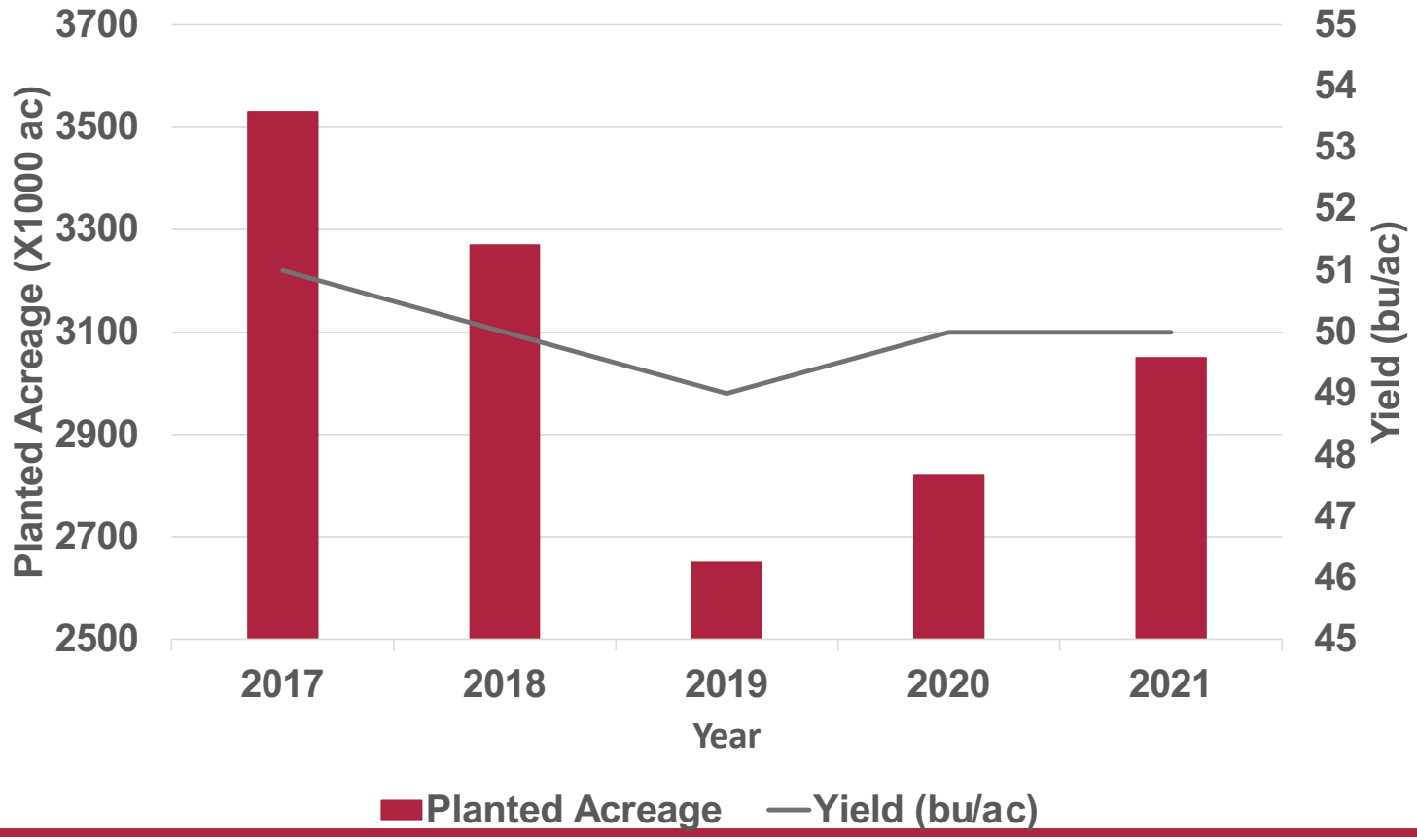
- 100% Extension Appointment
  - Hub for Soybean Production Recommendations/Education
  - Educate Producers, Crop Consultants, Industry Personnel, and other clientele
  - Educate County Extension Agents
  - Soybean/Edamame Research
  - State/Regional/National Presentations
  - Extension Publications/Social Media



Historical Acreage and Yield



5-Yr Avg. Acreage and Yield



Factors Associated with Soybean Production

- Soil Fertility
  - Proper soil sampling, soil testing, and fertilization
- Soil pH
  - Optimum soybean production from 6.5 – 7.0
- Drainage
  - Adequate drainage is essential
- Rotation
  - Increased soybean yields (5 bu/A common)
  - Breaking cycles of diseases, weeds, and insects

Factors Associated with Soybean Production

- Variety Selection
  - Most important decision
  - High yield potential with good “defensive” package
- Planting Date
  - Earlier plantings have potentially higher yield
- Row Spacing
  - Row spacings of 30 inches or less increase yield
- Pest Control (weed, disease, and insect)
  - Required to maximize yield

Present/Future Concerns

- High yield production
- Herbicide-resistant weeds
- Fungicide-resistant plant diseases
- Edamame production
- SRVP

1996

2016

2019

Conventional – non-GMO

2009

2019

2020

Soybean Variety Selection

- Most important and most difficult management decision
  - Foundation for the season
- When done properly, increase the chance for variety to reach full yield potential

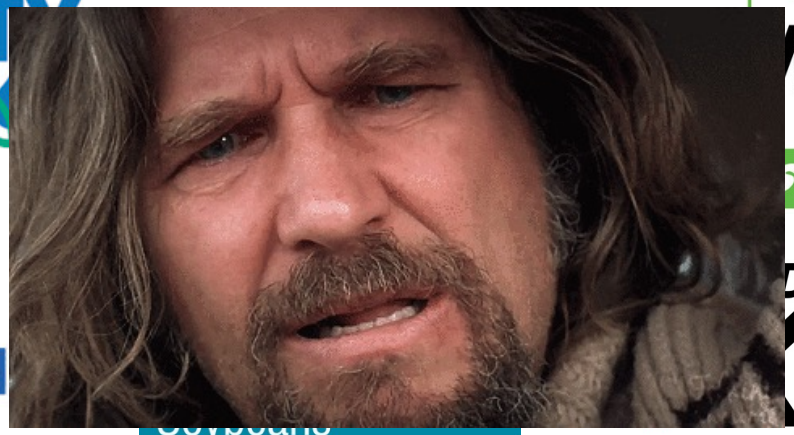
Soybean Varieties by Herb. Tech. (2011-2020)

	Year										
Herb Tech	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Totals
RR1	107	114	86	65	54	47	42	20	5	10	**550**
RR2	25	214	222	208	160	89	34	9	1	3	**965**
LL	30	36	45	69	72	45	45	47	10	2	**401**
Conv	25	20	21	28	34	42	36	26	15	15	**262**
Xtend	0	0	0	0	0	82	145	149	120	100	**596**
LLGT27	0	0	0	0	0	0	0	0	7	5	**12**
Enlist	0	0	0	0	0	0	0	0	33	36	**69**

Data from UADA's Soybean Variety Performance Trials (2011 -2020)

Herbicide Technologies - Soybean

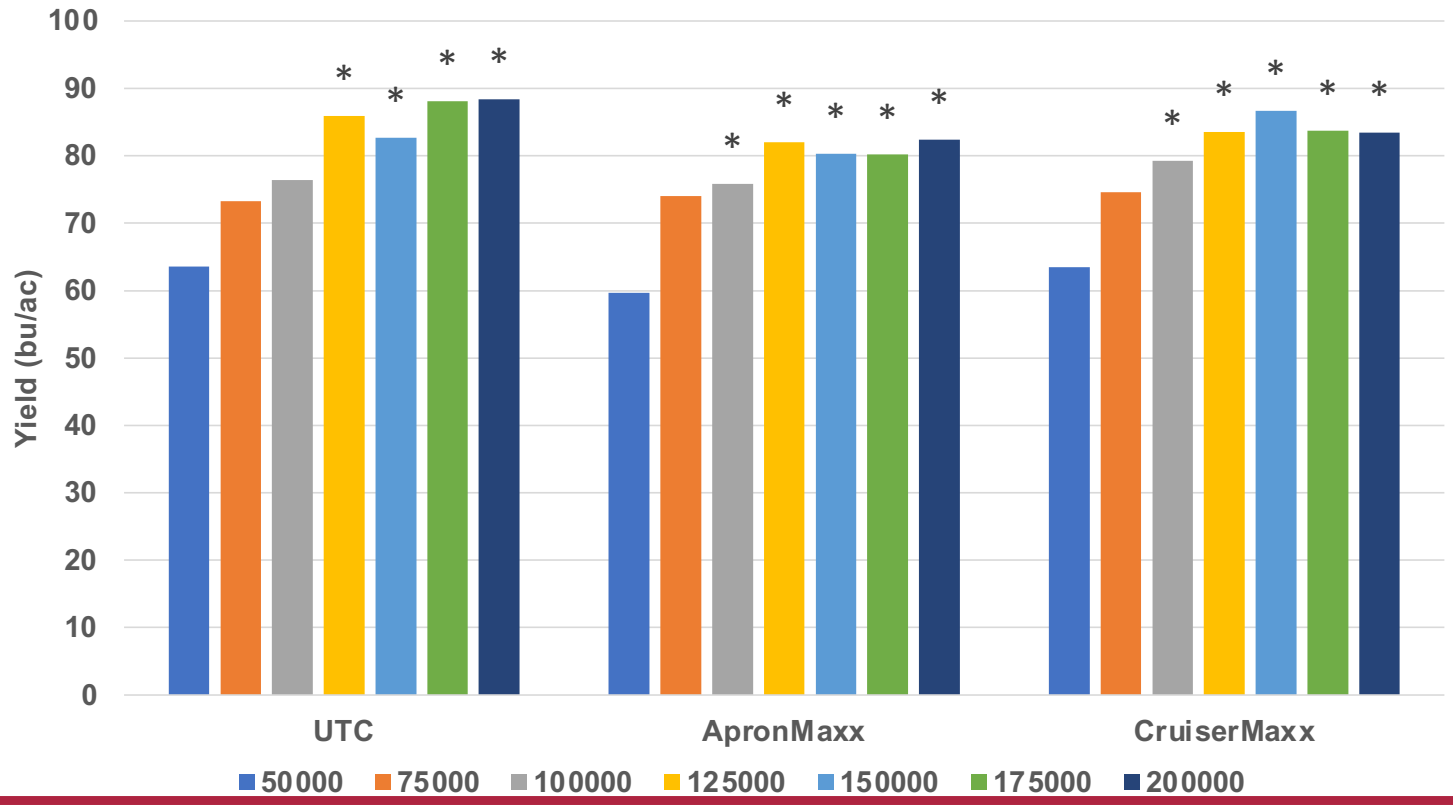
Conventional



What soybean variety do you recommend?

1. Glyphosate/PPO resistant weed issues?
   - Could determine herbicide technology
2. What is the soil texture of your field?
3. Do you have salt problems?
4. Are nematodes a problem?
5. Have you had disease problems?
6. Etc…….

2018 Seeding Rate X Seed Trt (PT)



LSD p = 0.10; 7.594

Conclusions

- Minimum plant stand of 75,000 plants/ac can maximize yield
  - **MUST BE UNIFORM STAND – NO SKIPS**
- Lower populations early in season can compensate, more timely pesticide applications
- Better to keep minimum stand late in the season than start over
- “Filling in” with additional seed did not significantly increase yield
- 110K seed/ac = 95% Max Yield; 150K seed/ac = 99% Max Yield; 180K = 100% Max Yield

Glyphosate-resistant Weeds

- Horseweed (2003)
- Common Ragweed (2004)
- Giant Ragweed (2005)
- **Palmer Amaranth (2006)**
- Johnsongrass (2007)
- Italian Ryegrass (2008)
- Tall Waterhemp (2015)

Herbicide resistant Palmer amaranth populations in 2021:

Glyphosate (Group 9)
ALS (Group 2)
PPO (Group 14)
DNA's (Group 3)
HPPD (Group 27)
VLCFA (Group 15)
Glufosinate (Group 10)

Management Techniques

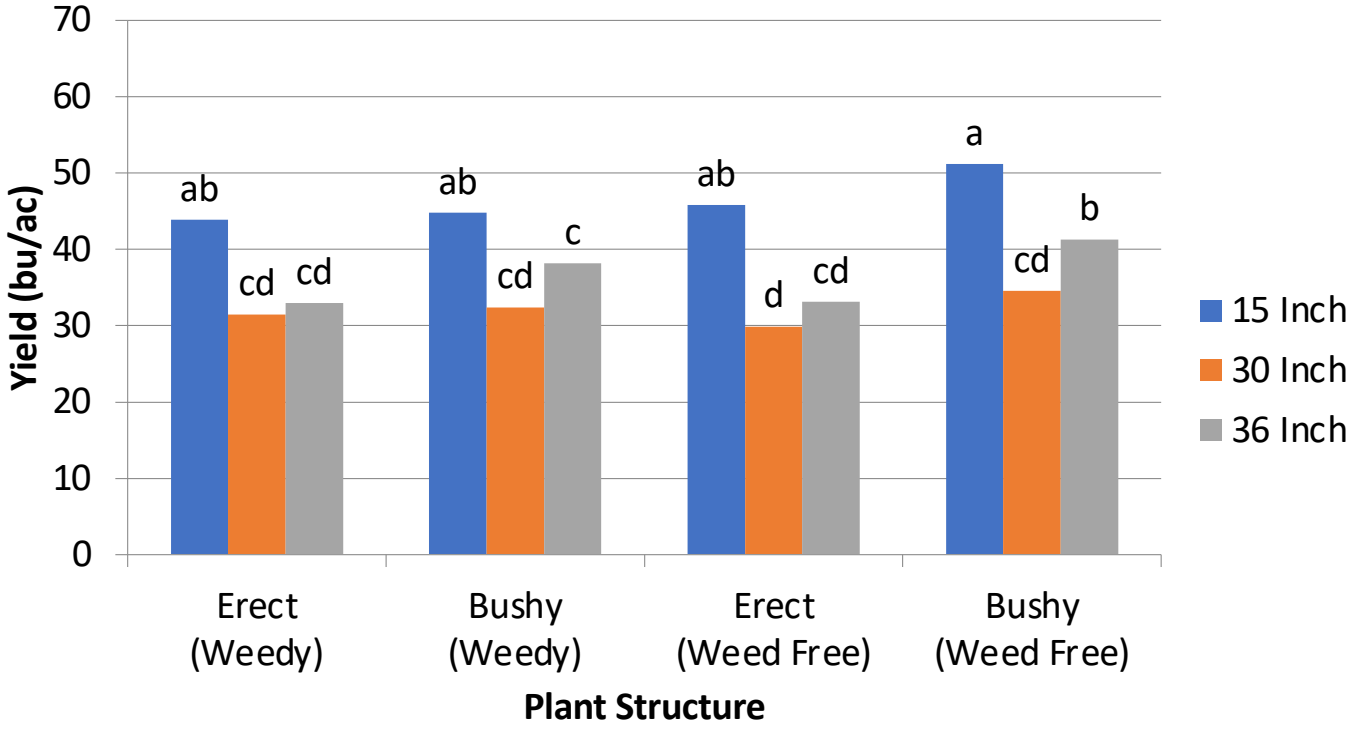
- Crop rotation
- Herbicide rotation
- Herbicide combinations
- Rotation of herbicide MOA
- Tillage


15 Inch Rows


30 Inch Rows


36 Inch Rows

2014 Width by Variety (MG IV)



Means followed by same letter are not significantly different (P = 0.10, LSD)

Seed Destruction and Removal at Harvest

*Hear*NPV (Heligen)

- *Hear*NPV is a virus that kills the host while making more virus
- Costs $3-6/acre
- Only kills budworm and bollworm
  - IDENTIFICATION IS KEY!

Confidence in an Application

- Takes 4-6 days to kill, but feeding stops before
- Prior to 4-6 days post application look for:
  - Reduced damage and feeding
  - Larvae moving to the top of the canopy
  - Decreased larval defense response
- After 4-6 days post application ALSO look for:
  - Sweating larvae
  - Liquefied larvae

National Soybean Foliar Fertilizer Research

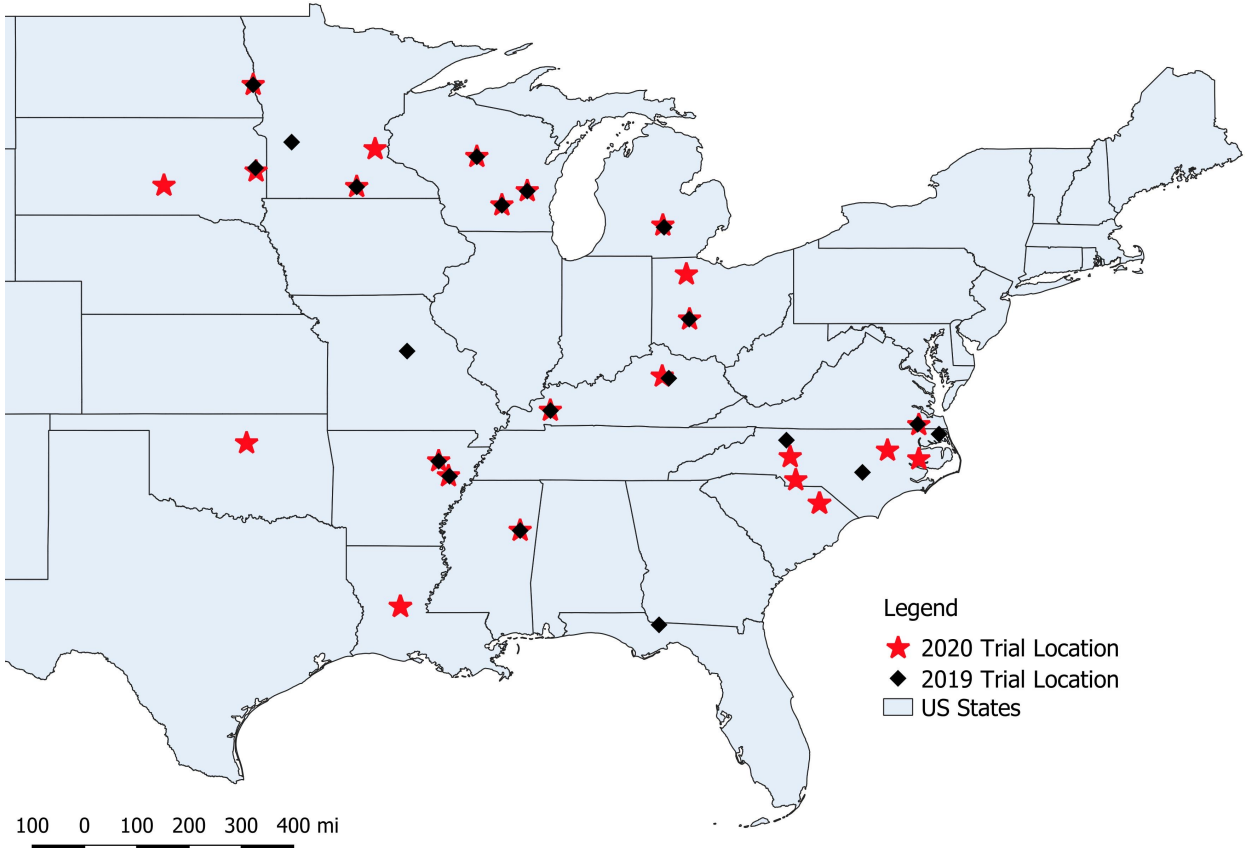
Objectives:

(1) Identify soybean grain yield response to prophylactic foliar fertilizer application across a broad range of environments

(2) Determine if foliar fertilizer application changes soybean grain composition

(3) Conduct economic analyses on the value of these products in U.S. soybean-growing environments.

Trial Overview



- Small plot field trials at 46 sites in 2019 and 2020
- RCB design with 4-8 reps per site-year
- Treatments were applied in the absence of visual symptoms of nutrient deficiency

Products and Nutrient Rates

Treatment Name	Application Rate	Cost of Product	N	P	K	S	Mn	Fe	Mo	Zn	B	Other
		USD ha^{-1}	kg ha^{-1}									
FertiRain	28.0 l ha^{-1}	$55	3.1	1.0	1.0	0.6	0.02	0.03	-	0.03	-	-
Sure-K	28.0 l ha^{-1}	$48	0.7	0.3	1.0	-	-	-	-	-	-	-
HarvestMore Ureamate	2.8 kg ha^{-1}	$12	0.1	0.3	-	-	0.01	-	0.002	0.01	-	Ca, Mg, B, Co, Cu
Smart B-Mo	1.2 l ha^{-1}	$9	-	-	-	-	-	-	0.007	-	0.08	-
Smart Quatro Plus	4.7 l ha^{-1}	$16	-	-	-	0.04	0.09	-	0.003	0.09	0.07	-
Maximum NPact K	14.0 l ha^{-1}	$52	2.1	-	2.1	-	-	-	-	-	-	-
Untreated Control	-	-	-	-	-	-	-	-	-	-	-	-

Analysis Methods

- Mixed-model ANOVA with replication as a random factor
- Kenward-Rogers approximation for degrees of freedom

		F-value	p-value
Yield	**Treatment (T)**	0.23	0.9663
	Site-year (S)	61.05	<0.001
	T × S	1.00	0.4812
Protein	**Treatment (T)**	1.37	0.2248
	Site-year (S)	557.92	<0.001
	T × S	1.15	0.0703
Oil	**Treatment (T)**	1.62	0.1382
	Site-year (S)	392.72	<0.001
	T × S	1.17	0.0490

Foliar Fertilizers Reduced Profitability (n=46)

Treatment	Prod. Cost	Avg Yield	Mean partial profit at soybean grain price of $15/bu	Mean partial profit at soybean grain price of $10/bu
	US$/ac	bu/ac	US$/ac	US$/ac
Untreated Control	---	59.4	891 a*	594 a
Smart B-Mo	$3.60	59.6	890 ab	592 a
HarvestMore UreaMate	$4.90	59.5	887 ab	590 a
Smart Quatro Plus	$6.50	58.9	878 ab	583 ab
FertiRain	$22.25	59.5	871 ab	573 b
Sure-K	$19.40	59.3	870 ab	573 b
Maximum NPact K	$21.00	59.2	867 b	571 b

*Means not sharing common letters within each column denote statistical differences among treatments (α = .05). Bonferroni adjustments were used to adjust for multiplicity.

Comparison of Fertilizer and Fuel Costs in 2021 versus 2022 for rice, soybean, and corn.

Input	Rice 2021	Rice 2022	Soybean 2021	Soybean 2022	Corn 2021	Corn 2022
Nitrogen (urea, 46-0-0)	$53.63	$140.25	--	--	$70.69	$184.88
Phosphate (0-46-0)	$15.44	$38.06	$15.98	$39.38	$31.06	$76.56
Potash (0-0-60)	$14.75	$41.25	$14.75	$41.25	$19.18	$53.63
Diesel, Pre-Post Harvest	$6.98	$10.24	$5.53	$11.29	$6.70	$10.89
Diesel, Harvest	$3.24	$5.27	$3.24	$5.27	$3.24	$5.27
Irrigation Energy Cost	$56.69	$86.81	$22.68	$36.85	$26.46	$42.99
	$150.73	$321.88	$62.18	$134.04	$157.33	$374.22
Increased Costs	$171.15		$71.86		$216.89	

- Rice – 330 lbs urea, 87 lbs phosphate, 100 lbs potash
- Soybean – 90 lbs phosphate, 100 lbs potash
- Corn – 435 lbs urea, 175 lbs phosphate, 130 lbs potash
- Diesel price of $1.60 in 2021; $2.60 in 2022

Arkansas ROW CROP VERIFICATION

UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE

COTTON

ARKANSAS WHEAT PROMOTION BOARD

ARKANSAS RICE CHECK-OFF

ARKANSAS SOYBEAN PROMOTION BOARD

ARKANSAS CORN & GRAIN SORGHUM BOARD

What is the Soybean Research Verification Program?

- Established in 1983
  - Funded by Arkansas Soybean Promotion Board with checkoff monies
- Interdisciplinary effort
- Verify research-based recommendations
- Improving profitability of Arkansas soybean production

Objectives

- To verify research-based recommendations
- To develop a database for economic analysis
- To demonstrate that consistently high yields can be produced
- To identify specific problems/opportunities
- Promote timely implementation of cultural/management practices
- Provide training

SRVP Field selection

- Large enough to represent actual field production
- Represent a major soil texture in county
- Adequate surface drainage

Implementation

- All production practices implemented at cooperator's expense
- Extension computerized programs used to make recommendations
  - Variety Selector, Irrigation Scheduler, etc.
- Complete records of field operations maintained

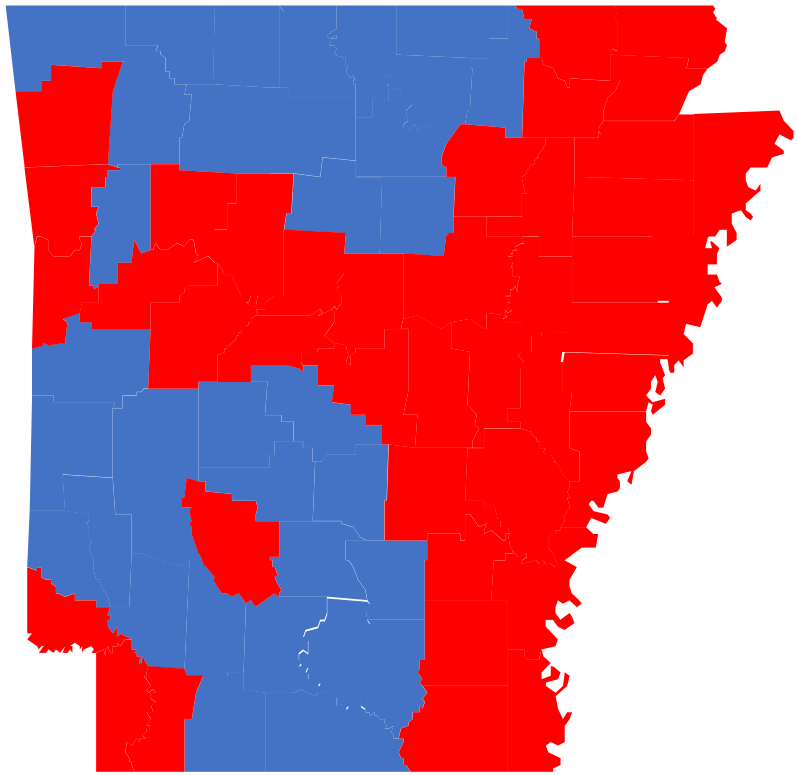
SRVP Coordinators

Chris Elkins
North Arkansas

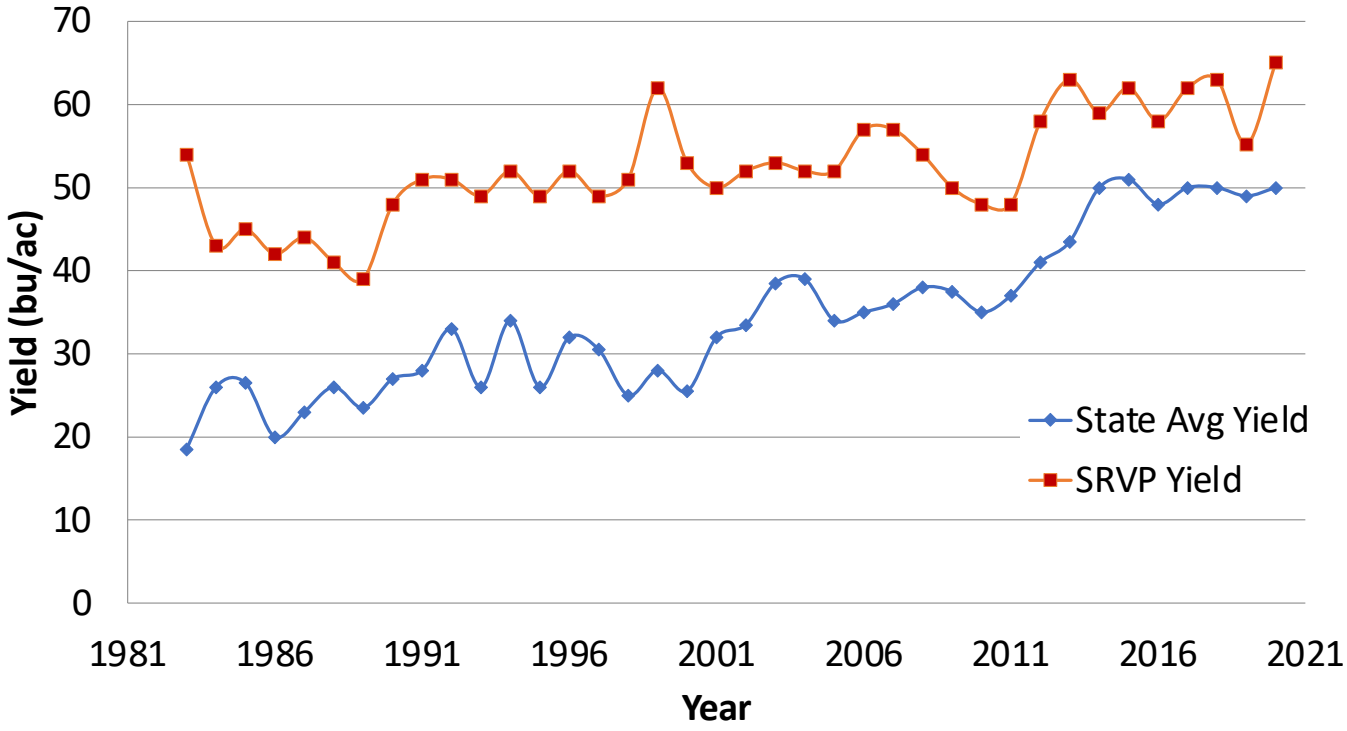
Chad Norton
South Arkansas

Counties that have participated in SRVP

- 600+ commercial soybean fields
- 41 counties



State Avg. Soybean Yield vs. SRVP Avg. Yield




UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE
Soybean Research
Verification Program
Craighead County
Cooperator: Chris Riggs
CES Agent: Eric Grant
Funded By: The Arkansas Soybean Promotion Board

Impacts of the SRVP

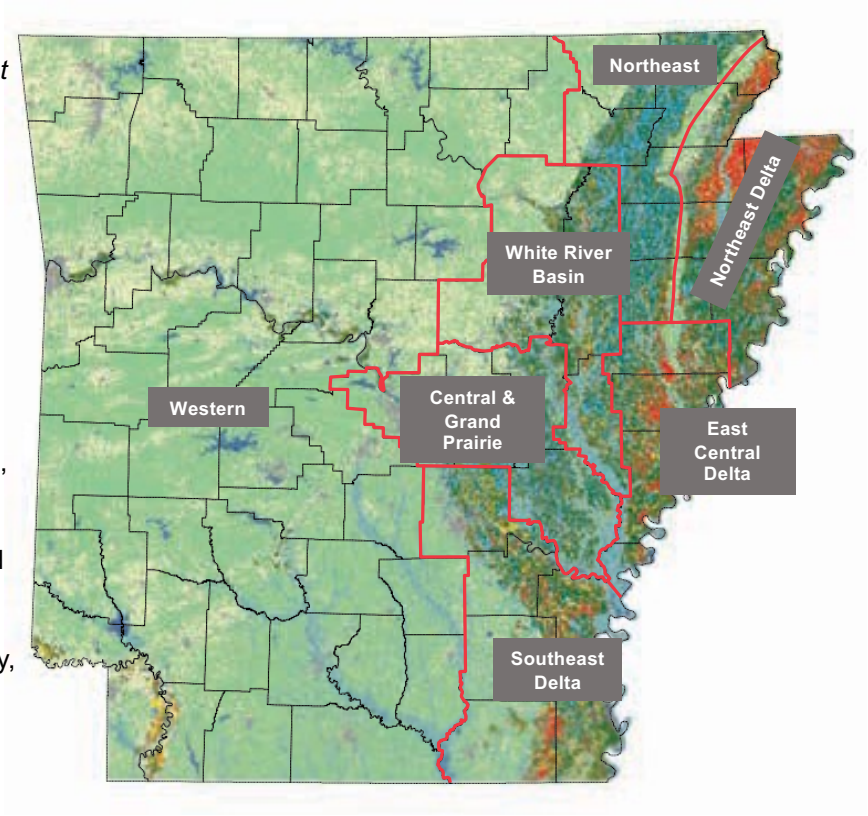
- Variety selection
- Timely practices
  - Irrigation, pesticide application, harvest, etc.
- IPM practices
- Economic database
- In-field training

Arkansas Soybean Yield Challenge

- Funded by Arkansas Soybean Promotion Board and administrated by Arkansas Soybean Association
- Started in 1999
- Changed to “Grow for the Green” Yield Contest in 2007
- Added “Race for 100” in 2007
  - 100 bu/a contest
- Divided entries into “Production Systems” in 2011
  - Early Season
  - Full Season
  - Double Crop
- Divided entries into geographical divisions in 2013

Arkansas Soybean Production Divisions

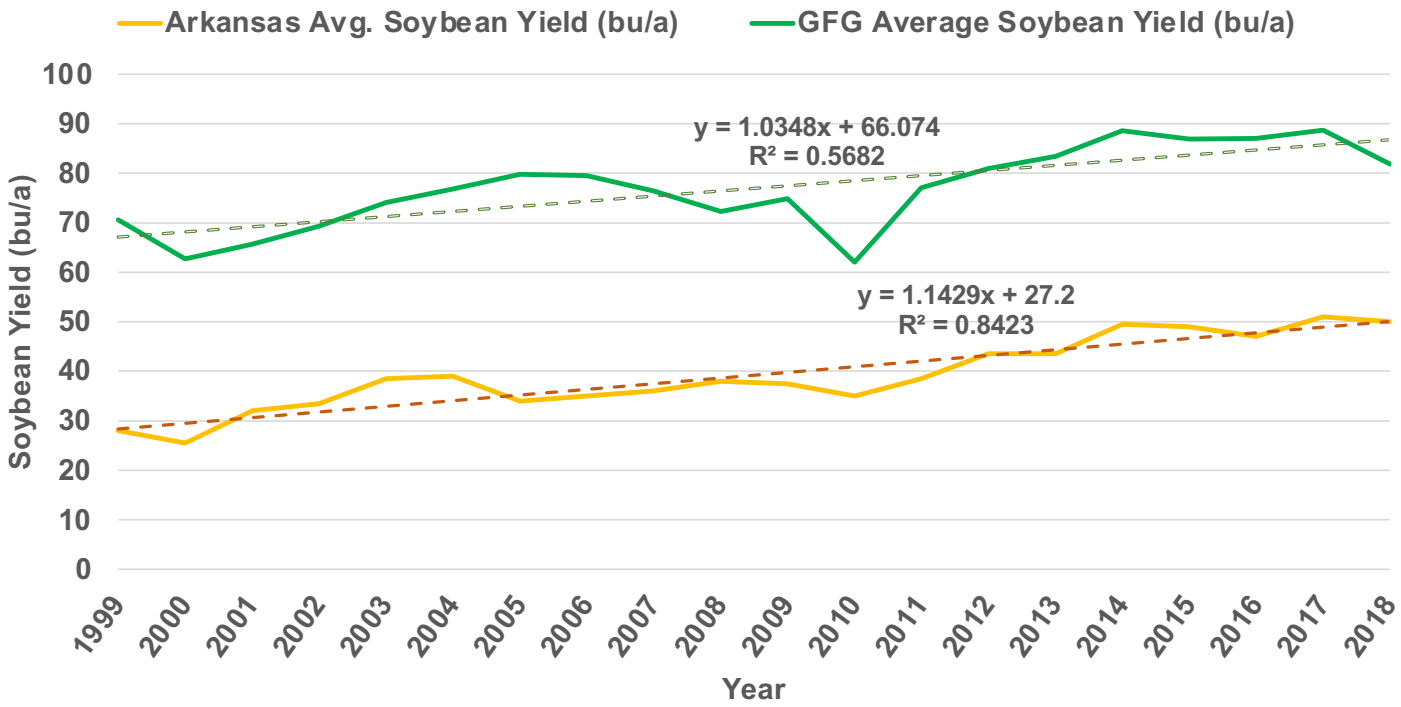
1. Northeast Delta: Mississippi, Crittenden *and East of Crowley's Ridge in Clay, Greene, Craighead, Poinsett, and Cross Counties*
2. Northeast: Randolph, Lawrence *and West of Crowley's Ridge in Clay, Greene, Craighead, Poinsett, and Cross Counties*
3. White River Basin: Independence, Jackson, Woodruff, White, and Monroe Counties
4. Central & Grand Prairie: Pulaski, Lonoke, Prairie, and Arkansas Counties
5. East Central Delta: St. Francis, Lee, Phillips, and *Desha (Snow Lake Area)* Counties
6. Southeast Delta: Jefferson, Lincoln, Drew, Ashley, Chicot, and Desha Counties
7. Western: Remainder of the state
8. Conventional Division: Entire State



Field Criteria

- Fields must be located within the land boundaries of Arkansas
- Limited to one producer/one division/one field
- Harvest area must consist of a minimum of five (5) contiguous acres and a maximum of seven (7) contiguous acres
- Harvest area must have four (4) straight sides, and harvest area must have four (4) right angles
- Field must have been planted to soybeans in at least one of the last 3 production years, and paid appropriate checkoff

Avg. Arkansas Soybean Yield vs. Grow for the Green Avg. Soybean Yield (1999-2018)



Production Practices

Year	No. Participants	Avg. Yield (bu/a)	Avg. Planting Date	Avg. Irrigations	Insecticide Application	Fungicides Application
1999	7	70.7	May-13	5.2	N/A	N/A
2000	10	62.8	May-14	9.6	N/A	N/A
2001	9	65.7	Apr-31	6.7	1	1
2002	6	69.3	May-6	4.0	3	2
2003	8	74.1	May-4	3.3	0	3
2004	7	76.8	May-4	6.2	2	5
2005	10	79.8	May-1	5.2	2	5
2006	7	79.5	Apr-26	6.0	1	4
2007	18	76.4	May-8	5.1	9	13
2008	10	72.3	May-17	4.7	7	10

Production Practices

Year	No. Participants	Avg. Yield (bu/a)	Avg. Planting Date	Avg. Irrigations	Insecticide Application	Fungicides Application
2009	10	74.9	May-4	4.8	6	9
2010	12	62.0	Apr-14	6.6	8	9
2011 (ES)	10	86.8	Apr-8	8.2	5	8
2011 (FS)	6	71.2	May-7	6.4	5	6
2011(DC)	3	77.3	Jun-8	5.5	2	2
2012 (ES)	15	89.1	Apr-13	7.1	8	13
2012 (FS)	6	79.3	May-9	9.7	3	5
2012 (DC)	8	65.1	May-29	5.8	5	6

Production Practices

Year	No. Participants	Avg. Yield (bu/a)	Avg. Planting Date	Avg. Irrigations	Insecticide Application	Fungicides Application
2013	58	83.5	May-4	6.7	46	52
2014	50	88.6	Apr-28	5.1	30	40
2015	38	86.9	Apr-27	6.5	26	30
2016	44	87.0	Apr-26	6.1	22	36
2017	53	88.7	Apr-16	4.8	39	46
2018	40	81.8	Apr-23	5.7	17	31
2019	32	87.8	May-4	4.0	17	24
2020	33	82.7	May-1	5.4	17	28

100 bu/a Winners

Year	Name	Variety	Planting Date	Seeding Rate (seed/a)	Row Spacing (inches)	Yield (bu/a) 13%
2013	Matt Miles	Asgrow AG4632	Apr-23	170,000	38-twin	107.6
2013	Eddie Tackett	Pioneer 94Y70	May-13	150,000	30	104.8
2013	Nelson Crow	Pioneer 93Y92	Apr-24	145,000	30	100.8
2014	David Bennett	Asgrow AG4632	Apr-22	150,000	38	112.0
2014	Sherrie Miles	Pioneer 48T53	Apr-23	157,000	38-twin	106.5
2014	Matt Miles	Pioneer 45T11	Apr-18	157,000	38-twin	100.6
2015	Perry Galloway	Pioneer 46T21	Apr-30	140,000	38-twin	108.8
2015	Matt Miles	Pioneer 47T36	Apr-4	160,000	38-twin	108.7
2015	Charles Galloway	Asgrow 4232	Apr-6	140,000	38”-twin	100.9

100 bu/a Winners

Year	Name	Variety	Planting Date	Seeding Rate (seed/a)	Row Spacing (inches)	Yield (bu/a) 13%
2016	James Wray	Pioneer 47T36	Apr-12	125,000	38-twin	118.8
2016	James E. Wray, Jr.	Pioneer 47T36	Apr-9	125,000	38-twin	109.7
2016	Barbara Wray	Pioneer 47T36	Apr-8	125,000	38-twin	109.8
2016	Michael Taylor, Jr.	Asgrow 47X6	Apr-8	145,000	30	101.3
2016	Martin Henry	Armor 48-D24	Apr-5	165,000	30	113.9
2016	Layne Miles	NK S47-K5	May-6	160,000	38-twin	101.0

100 bu/a Winners

Year	Name	Variety	Planting Date	Seeding Rate (seed/a)	Row Spacing (inches)	Yield (bu/a) 13%
2017	James E. Wray, Jr.	Asgrow AG46X6	Apr-12	125,000	38-twin	103.8
2017	James Wray	Asgrow AG46X6	Apr-10	125,000	38-twin	105.9
2017	Billy Wayne Tripp	Asgrow AG46X6	Aprr-12	145,000	30-twin	100.5
2017	Mary Galloway	Hefty H49X7s	Apr-10	140,000	15	107.6
2017	Perry Galloway	Hefty H48X7	Apr-12	140,000	15	108.9
2017	Jason Berry	Pioneer P46A16	Apr-5	140,000	38-twin	102.9
2017	John Newkirk	Asgrow AG46X6	Apr-4	136,000	30	104.0
2017	Matt Miles	Pioneer P47T36	Apr-8	150,000	38-twin	105.0
2017	Layne Miles	Pioneer P47T36	May-29	150,000	38-twin	108.1
2018	William Palsa	Local Seed LS4565XS	Apr-21	150,000	7.5	107.4

100 bu/a Winners

Year	Name	Variety	Planting Date	Seeding Rate (seed/a)	Row Spacing (inches)	Yield (bu/a) 13%
2019	Matt Miles	Pioneer P48A60X	Apr-22	155,000	38-twin	120.533
2019	Billy Garner	Pioneer P48A60X	May-15	155,000	38-twin	116.636
2019	Drew Counce	Pioneer P46A16R	Apr-25	140,000	30	103.883
2019	Sherrie Miles	Pioneer P48A60X	Apr-29	150,000	38-twin	101.007
2019	Layne Miles	Pioneer P48A60X	May-1	155,000	38-twin	117.251
2019	Mark Wetly	Pioneer P48A60X	Apr-24	140,000	38-twin	103.702
2019	Brandon Cain	NK S45-J3X	Apr-3	170,000	30	100.200

100 bu/a Winners

Year	Name	Variety	Planting Date	Seeding Rate (seed/a)	Row Spacing (inches)	Yield (bu/a) 13%
2020	Matt Miles	Pioneer P47A64X	Apr-10	155,000	38-twin	116.858
2020	Ronnie Ragsdell	Pioneer P48A60X	Apr-10	140,000	30	104.067

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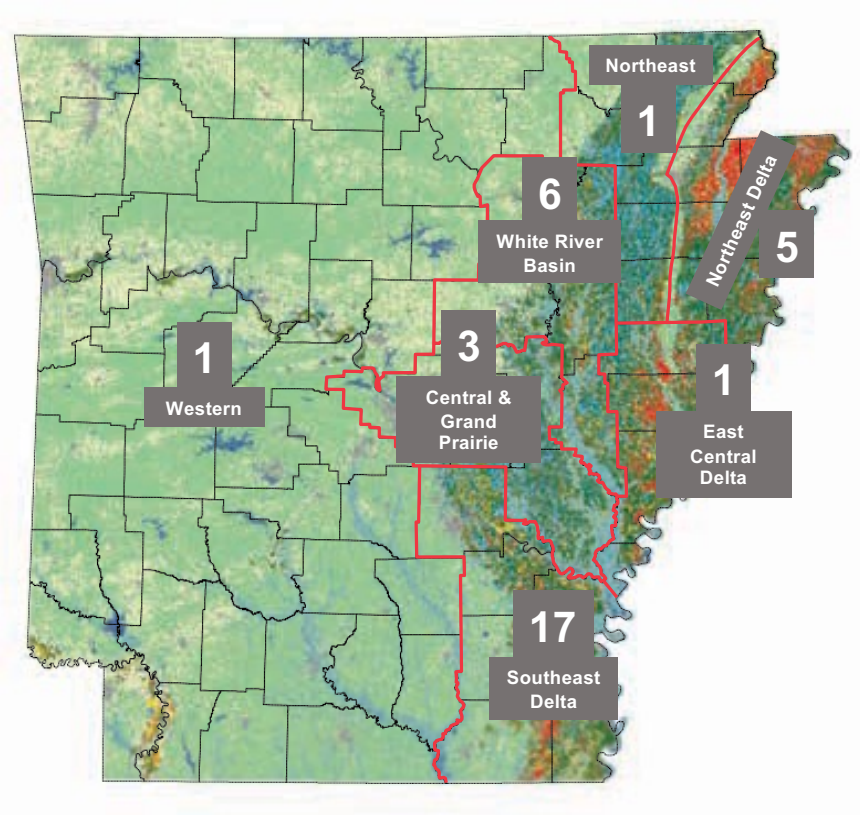

GFTG Summary/Conclusions

- Yield trends for Arkansas Sate Avg. Yield and GFG Avg. Yield are similar across years
- Many producers follow Univ. of Ark. production recommendations
- Increase in irrigations frequency over years
  - Weather dependent
- Increase in insecticide/fungicide application
  - Fungicide application for plant health?
- All 100 bu/a winners on wide-row (twin-row system)
- Majority of fields in rotation with corn (little rice and soybean/soybean)
- Majority of fields are silt loam in texture
- Economic data is being analyzed

Questions

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Row Crops Blog

https://arkansascrops.uada.edu/

Twitter

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