

ARKANSAS SOYBEAN PROMOTION BOARD

Minutes

January 10, 2024

9:30 a.m.

Member(s) present: Josh Cureton, Brad Doyle, Joe Thrash, Rusty Smith, John Freeman, West Higginbothom, Donald Morton, Shannon Davis

Member(s) present via Zoom: Douglas Hartz

Chair John Freeman called the meeting to order and welcomed members and guests.

**Moved by Thrash, seconded by Morton to approve the November 3, 2023 meeting minutes with the correction that Douglas Hartz was present via zoom at the meeting and not absent.**

**Motion carried.**

Inoussa Zaki, Chief Fiscal Officer, presented the Arkansas Soybean Promotion Board Financial Statement shown as **Attachment 1**, Graph with USDA NASS Forecast Data shown as **Attachment 2**, and Arkansas Soybean Promotion Board Annual Financial Report from Legislative Audit Committee shown as **Attachment 3**.

Chair John Freeman discussed a pre-approval for reimbursable expenses for the year 2024.

**Moved by Davis, seconded by Smith to approve. Hartz opposed.**

**Motion carried.**

Carson Horn presented a closeout summary of the work performed for the Arkansas Soybean Promotion Board. **Attachment 4**.

March 6<sup>th</sup> & 7<sup>th</sup> was set to be the dates for the funding meeting.

Dr. Nathan McKinney, University of Arkansas, presented the board with an application for a new Fellow. **Attachment 5**.

**Moved by Davis, seconded by Cureton to approve the new fellowship.**

**Motion carried.**

Meeting adjourned.

  
\_\_\_\_\_  
John Freeman, Chairman

<b>Arkansas Soybean Promotion Board</b>			
<b>Financial Statement</b>			
<b>For The Period July 1, 2023 - December 31, 2023</b>			
	<b>June 2023</b>	<b>December 2023</b>	<b>Budget 2023</b>
Beginning Balance	\$ 6,231,490	\$ 9,347,445	\$ 7,814,674
<b>Revenue</b>			
Total Collections	\$ 10,663,495	\$ 6,424,039	\$ 6,982,638
Less			
USB Transfer	\$ 4,948,222	\$ 2,988,958	\$ 3,491,319
Other QSSB Transfers	\$ 438,553	\$ 319,957	\$ 447,665
State Collection Fee	\$ 317,198	\$ 189,541	\$ 216,462
Net Transfer to the Board	\$ 4,959,521	\$ 2,925,582	\$ 2,827,192
Other Income	\$ 4,276	\$ 35,000	
<b>Total Revenue</b>	<b>\$ 4,963,797</b>	<b>\$ 2,960,582</b>	<b>\$ 2,827,192</b>
<b>Expenses</b>			
Promotion	\$ 590,162	\$ 131,541	\$ 661,015
Research	\$ 1,239,261	\$ 1,585,989	\$ 4,160,001
Board Expenses	\$ 18,510	\$ 8,340	\$ 41,004
<b>Total Expenses</b>	<b>\$ 1,847,932</b>	<b>\$ 1,725,870</b>	<b>\$ 4,862,020</b>
Cancelled Checks			
Ending Balance	\$ 9,347,354	\$ 10,582,157	\$ 5,779,846
Remaining Allocation			
Other Liabilities	\$ 46,691	\$ -	
Research	\$ 1,485,989	\$ -	\$ 2,000,000
Promotion	\$ -	\$ -	
<b>Total Remaining Allocation</b>	<b>\$ 1,532,680</b>	<b>\$ -</b>	<b>\$ 2,000,000</b>
Revenue less Expenses			
Funds Available	\$ 7,814,674	\$ 10,582,157	\$ 3,779,846

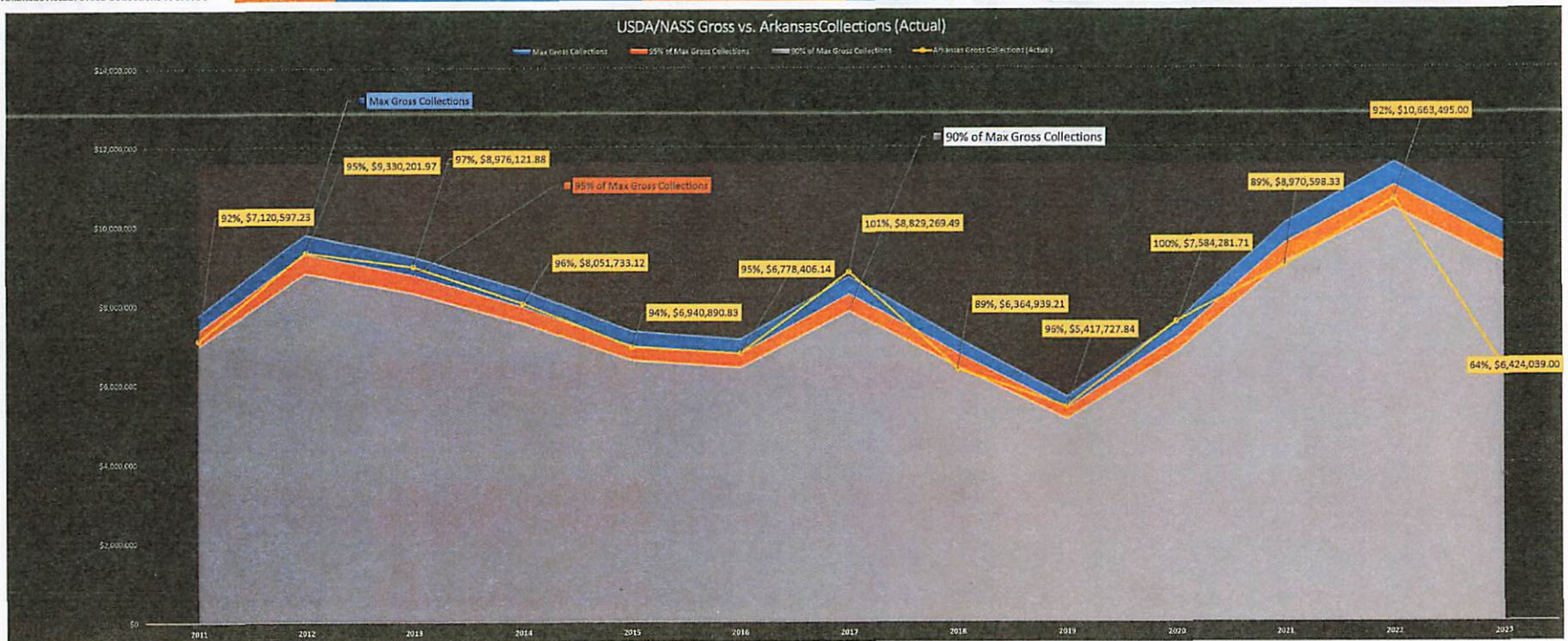
**Arkansas Soybean Promotion Board  
Annual Collections**

	June 2023	December 2023	Budget 2023	Estimated Budget 2024		
<b>USDA Soybean Estimates</b>						
NASS SOYBEANS - ACRES PLANTED	3,180,000	2,980,000	3,180,000	2,980,000	2,980,000	2,980,000
NASS SOYBEANS - ACRES HARVESTED	3,150,000	2,950,000	3,140,000	2,950,000	2,950,000	2,950,000
NASS SOYBEANS - YIELD, MEASURED IN BU / ACRE	50	53	52	53	53	53
NASS SOYBEANS - PRODUCTION, MEASURED IN BU	157,500,000	156,350,000	163,280,000	156,350,000	156,350,000	156,350,000
NASS SOYBEANS - PRICE RECEIVED, MEASURED IN \$ / BU	\$ 12.00	\$ -	\$ 14.20	\$ -	\$ -	\$ -
NASS Value	\$ 1,890,000,000	\$ -	\$ 2,318,576,000	\$ -	\$ -	\$ -
Implied Checkoff Based on NASS	\$ 9,450,000	\$ -	\$ 11,592,880	\$ -	\$ -	\$ -
<b>Total Soybean Checkoff Collections For Arkansas</b>				100%	95%	90%
Assessed Bushels	151,466,018.00	97,171,980	100,043,795.00	156,350,000	148,532,500	140,715,000
Assessed Bushels Value	2,131,149,999.84	1,296,673,758	1,368,085,551.00	\$ -	\$ -	\$ -
In State Collections	\$ 10,235,500.48	\$ 6,302,773.12	\$ 6,843,508.18	\$ -	\$ -	\$ -
Out of State Collections	\$ 427,994.29	\$ 121,265.53	\$ 139,129.46	\$ -	\$ -	\$ -
Total Checkoff Collections	\$ 10,663,494.77	\$ 6,424,038.65	\$ 6,982,637.64	\$ -	\$ -	\$ -
Implied Price	\$ 14.07	\$ 13.34	\$ 13.67	\$ -	\$ -	\$ -
<b>Net Collections for Arkansas Soybeans</b>						
Total Checkoff Collections	\$ 10,663,495	\$ 6,424,039	\$ 6,982,638	\$ -	\$ -	\$ -
QSSB Transfer						
Alabama	\$ 9	\$ -	\$ -	\$ -	\$ -	\$ -
Colorado	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Florida	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Georgia	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Illinois	\$ 1,562	\$ 1,083	\$ 920	\$ -	\$ -	\$ -
Indiana	\$ 288	\$ -	\$ -	\$ -	\$ -	\$ -
Iowa	\$ 114	\$ -	\$ -	\$ -	\$ -	\$ -
Kansas	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Kentucky	\$ 1,758	\$ -	\$ -	\$ -	\$ -	\$ -
Louisiana	\$ 4,491	\$ 3,021	\$ 2,366	\$ -	\$ -	\$ -
Michigan	\$ 4,287	\$ -	\$ 4,287	\$ -	\$ -	\$ -
Minnesota	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Mississippi	\$ 192,887	\$ 122,313	\$ 129,450	\$ -	\$ -	\$ -
Missouri	\$ 202,526	\$ 180,681	\$ 156,542	\$ -	\$ -	\$ -
Nebraska	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Ohio	\$ 2,449	\$ -	\$ 2,449	\$ -	\$ -	\$ -
Oklahoma	\$ 265	\$ 1,637	\$ 265	\$ -	\$ -	\$ -
Tennessee	\$ 24,019	\$ 4,941	\$ 21,889	\$ -	\$ -	\$ -
Texas	\$ 3,645	\$ 6,282	\$ 21,889	\$ -	\$ -	\$ -
Wisconsin	\$ 254	\$ -	\$ 254	\$ -	\$ -	\$ -
TOTAL QSSB Transfer	\$ 438,553	\$ 319,957	\$ 447,665	\$ -	\$ -	\$ -
United Soybean Board Payment	\$ 4,948,222	\$ 2,988,958	\$ 3,491,319	\$ -	\$ -	\$ -
Arkansas Misc Tax Collection Fee	\$ 317,198	\$ 189,541	\$ 216,462	\$ -	\$ -	\$ -
<b>Net Transfer to the Board</b>	\$ 4,970,080.35	\$ 2,925,581.89	\$ 3,135,727.59	\$ -	\$ -	\$ -
Difference from Budget						
<b>Net Arkansas Assessed Soybean Bushels</b>						
Gross Transfers to the Board	\$ 10,235,500.48	\$ 6,104,081.36	\$ 6,843,508.18	\$ -	\$ -	\$ -
Bushels Assessed	151,466,018	97,171,980	100,043,795	\$ 156,350,000	\$ 148,532,500	\$ 140,715,000
Implied Price	14.07	13.34	13.67	\$ -	\$ -	\$ -
NASS Soybean Production Estimate	157,500,000	156,350,000	163,280,000	\$ 156,350,000	\$ 156,350,000	\$ 156,350,000
Bushel Difference	6,033,982	59,178,020	63,236,205	\$ -	\$ 7,817,500	\$ 15,635,000
Percent of Bushels Assessed	96.2%	62.2%	61.3%	100%	95%	90%
Uncollected Checkoff	\$ 424,495	\$ 3,948,391	\$ 4,323,733	\$ -	\$ -	\$ -
Percent Checkoff Collected	108%	#DIV/0!	59%	#DIV/0!	#DIV/0!	#DIV/0!
Remainder Due to State	\$ 212,247.62	\$ 1,974,195.28	\$ 2,161,866.67	\$ -	\$ -	\$ -

## Attachment 2

**Draft USDA NASS Forecast From Data Released October 11, 2023 Numbers**  
**Arkansas soybean acreage, yield, production, price, and check-off rate with estimated maximum gross collections for years 2011 to 2023**

Production Year Fiscal Year, July 1 - June 30	2011 FY-2012	2012 FY-2013	2013 FY-2014	2014 FY-2015	2015 FY-2016	2016 FY-2017	2017 FY-2018	2018 FY-2019	2019 FY-2020	2020 FY-2021	2021 FY-2022	2022 FY-2023	2023 FY-2024 Estimate
Planted Acres	3,330,000	3,200,000	3,270,000	3,230,000	3,200,000	3,130,000	3,530,000	3,270,000	2,650,000	2,820,000	3,040,000	3,180,000	2,980,000
Harvested Acres	3,280,000	3,150,000	3,240,000	3,200,000	3,170,000	3,090,000	3,500,000	3,210,000	2,610,000	2,800,000	3,000,000	3,140,000	2,950,000
Yield, measured in bushels / acre	38.5	43.5	43.5	49.5	49	47	51	50.5	49	51.5	52	52	53
Production, measured in bushels	126,280,000	137,025,000	140,940,000	158,400,000	155,330,000	145,230,000	178,500,000	162,105,000	127,890,000	144,200,000	156,000,000	163,280,000	156,350,000
Price received, measured in \$ / bushels	\$12.30	\$14.30	\$13.10	\$10.60	\$9.46	\$9.83	\$9.77	\$8.81	\$8.87	\$10.50	\$12.90	\$14.20	\$12.90
<b>Total Estimated Value of Production</b>	\$1,553,244,000	\$1,959,457,500	\$1,846,314,000	\$1,679,040,000	\$1,469,421,800	\$1,427,510,900	\$1,743,945,000	\$1,428,145,050	\$1,134,384,300	\$1,514,100,000	\$2,012,400,000	\$2,318,576,000	\$2,016,915,000
Rate	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Max Gross Collections	\$7,766,220	\$9,797,288	\$9,231,570	\$8,395,200	\$7,347,109	\$7,138,055	\$8,719,725	\$7,140,725	\$5,671,922	\$7,570,500	\$10,062,000	\$11,592,880	\$10,084,575
95% of Max Gross Collections	\$7,377,909	\$9,307,423	\$8,769,982	\$7,975,440	\$6,979,754	\$6,781,152	\$8,283,739	\$6,783,689	\$5,388,325	\$7,191,975	\$9,558,900	\$11,013,236	\$9,580,346
90% of Max Gross Collections	\$6,989,598	\$8,817,559	\$8,308,413	\$7,555,680	\$6,612,398	\$6,424,249	\$7,847,753	\$6,426,653	\$5,104,729	\$6,813,450	\$9,055,800	\$10,433,592	\$9,076,118
Arkansas Gross Collections (Actual)	\$7,120,597.23	\$9,330,201.97	\$8,976,121.88	\$8,051,733.12	\$6,940,890.83	\$6,778,406.14	\$8,829,269.49	\$6,364,939.21	\$5,417,727.84	\$7,584,281.71	\$8,970,598.33	\$10,663,495.00	\$6,424,039.00
Arkansas Actual Gross Collections % of MGC	92%	95%	97%	96%	94%	95%	101%	89%	98%	100%	89%	92%	64%



**ARKANSAS SOYBEAN PROMOTION BOARD**

**Annual Financial Report**

**June 30, 2023**



**ARKANSAS SOYBEAN PROMOTION BOARD  
TABLE OF CONTENTS  
FOR THE YEAR ENDED JUNE 30, 2023**

**Independent Auditor's Report  
Report on Internal Control Over Financial Reporting and on Compliance and  
Other Matters Based on an Audit of Financial Statements Performed in  
Accordance with *Government Auditing Standards***

**FINANCIAL STATEMENTS**

	<u>Exhibit</u>
Balance Sheet – Governmental Fund	A
Statement of Revenues, Expenditures, and Changes in Fund Balance – Governmental Fund	B
Statement of Revenues, Expenditures, and Changes in Fund Balance – Budget and Actual – General Fund	C
Notes to Financial Statements	

**SUPPLEMENTARY INFORMATION**

	<u>Schedule</u>
Schedule of Expenditures by General Ledger Code	1

**OTHER INFORMATION (Unaudited)**

	<u>Schedule</u>
Schedule of Selected Information	2

# Arkansas



Sen. David Wallace  
Senate Chair  
Sen. John Payton  
Senate Vice Chair

Rep. Jimmy Gazaway  
House Chair  
Rep. Richard Womack  
House Vice Chair

Roger A. Norman, JD, CPA, CFE, CFF  
Legislative Auditor

## LEGISLATIVE JOINT AUDITING COMMITTEE ARKANSAS LEGISLATIVE AUDIT

### Independent Auditor's Report

Arkansas Soybean Promotion Board  
Legislative Joint Auditing Committee

#### Report on the Audit of the Financial Statements

##### *Opinion*

We have audited the financial statements of the major fund of the Arkansas Soybean Promotion Board, a board of Arkansas state government, as of and for the year ended June 30, 2023, and the related notes to the financial statements, which collectively comprise the Arkansas Soybean Promotion Board's departmental financial statements as listed in the table of contents.

In our opinion, the accompanying financial statements referred to above present fairly, in all material respects, the financial position of the major fund of the Arkansas Soybean Promotion Board as of June 30, 2023, the changes in financial position, and the budgetary comparison for the general fund for the year then ended in accordance with accounting principles generally accepted in the United States of America.

##### *Basis for Opinion*

We conducted our audit in accordance with auditing standards generally accepted in the United States of America (GAAS) and the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are required to be independent of the board and to meet our other ethical responsibilities, in accordance with the relevant ethical requirements relating to our audit. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

##### *Emphasis of Matter*

As indicated above, the financial statements of the Arkansas Soybean Promotion Board are intended to present the financial position, the changes in financial position, and budgetary comparisons of only that portion of the major fund of the State that is attributable to the transactions of the Arkansas Soybean Promotion Board. They do not purport to, and do not, present fairly the financial position of the State of Arkansas as of June 30, 2023, the changes in its financial position, or its budgetary comparisons for the year then ended, in accordance with accounting principles generally accepted in the United States of America. Our opinion is not modified with respect to this matter.

##### *Responsibilities of Management for the Financial Statements*

Management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America and for the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatements, whether due to fraud or error.

In preparing the financial statements, management is required to evaluate whether there are conditions or events, considered in the aggregate, that raise substantial doubt about the board's ability to continue as a going concern for twelve months beyond the financial statement date, including any currently known information that may raise substantial doubt shortly thereafter.



### ***Auditor's Responsibilities for the Audit of the Financial Statements***

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not absolute assurance and, therefore, is not a guarantee that an audit conducted in accordance with GAAS and *Government Auditing Standards* will always detect a material misstatement when it exists. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control. Misstatements are considered material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements.

In performing an audit in accordance with GAAS and *Government Auditing Standards*, we:

- Exercise professional judgement and maintain professional skepticism throughout the audit.
- Identify and assess the risk of material misstatements of the financial statements, whether due to fraud or error, and design and perform audit procedures responsive to those risks. Such procedures include examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances but not for the purpose of expressing an opinion on the effectiveness of the board's internal control. Accordingly, no such opinion is expressed.
- Evaluate the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluate the overall presentation of the financial statements.
- Conclude whether, in our judgment, there are conditions or events, considered in the aggregate, that raise substantial doubt about the board's ability to continue as a going concern for a reasonable period of time.

We are required to communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit, significant audit findings, and certain internal control-related matters that we identified during the audit.

### ***Required Supplementary Information***

The Governmental Accounting Standards Board requires that a Management's Discussion and Analysis be presented to supplement government-wide financial statements. However, as discussed in the "Emphasis of Matter" paragraph above, the financial statements of the Arkansas Soybean Promotion Board are only for the specific transactions and activity of the Agency and not for the State as a whole. Therefore, the Management's Discussion and Analysis is not required to be presented for the Arkansas Soybean Promotion Board individually. Our opinion on the departmental financial statements is not affected by the omission of this information.

### ***Supplementary Information***

Our audit was conducted for the purpose of forming an opinion on the financial statements that collectively comprise the Arkansas Soybean Promotion Board's departmental financial statements. The Schedule of Expenditures by General Ledger Code is presented for purposes of additional analysis and is not a required part of the departmental financial statements. Such information is the responsibility of management and was derived from and relates directly to the underlying accounting and other records used to prepare the departmental financial statements. The information has been subjected to the auditing procedures applied in the audit of the departmental financial statements and certain additional procedures, including comparing and reconciling such information directly to the underlying accounting and other records used to prepare the departmental financial statements or to the departmental financial statements themselves, and other additional procedures in accordance with auditing standards generally accepted in the United States of America. In our opinion, the Schedule of Expenditures by General Ledger Code is fairly stated, in all material respects, in relation to the departmental financial statements as a whole.

**Other Information**

Management is responsible for the other information included in the report. The other information comprises the Schedule of Selected Information but does not include the departmental financial statements, supplementary information, and our auditor's reports thereon. Our opinion on the departmental financial statements does not cover the other information, and we do not express an opinion or any form of assurance thereon.

In connection with our audit of the departmental financial statements, our responsibility is to read the other information and consider whether a material inconsistency exists between the other information and the financial statements or the other information otherwise appears to be materially misstated. If, based on the work performed, we conclude that an uncorrected material misstatement of the other information exists, we are required to describe it in our report.

**Reports on Other Legal and Regulatory Requirements**

*Other Reporting Required by Government Auditing Standards*

In accordance with *Government Auditing Standards*, we have also issued our report dated October 19, 2023, on our consideration of the board's internal control over financial reporting and on our tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements and other matters. The purpose of that report is solely to describe the scope of our testing of internal control over financial reporting and compliance, and the results of the testing, and not to provide an opinion on the effectiveness of the board's internal control over financial reporting or on compliance. That report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the board's internal control over financial reporting and compliance.

*Other Reporting Required by the Soybean Promotion, Research and Consumer Information Act of 1990 and the Soybean Promotion and Research Order*

In connection with our audit, nothing came to our attention that caused us to believe the Arkansas Soybean Promotion Board failed to comply with the terms, insofar as they relate to accounting matters, of the Soybean Promotion, Research, and Consumer Information Act of 1990 and the Soybean Promotion and Research Order (the "Order") relative to the use of funds collected by the Arkansas Soybean Promotion Board; with the terms described in Section 1220.228(a) of the Order relative to the prohibited use of funds collected by the Arkansas Soybean Promotion Board; and with the provisions of Section 1220.211(j) of the Order relative to the investment of funds collected by the Arkansas Soybean Promotion Board. However, our audit was not directed primarily toward obtaining knowledge of such noncompliance.

ARKANSAS LEGISLATIVE AUDIT



Roger A. Norman, JD, CPA, CFE, CFF  
Legislative Auditor

Little Rock, Arkansas  
October 19, 2023  
SA0932923

# Arkansas

Sen. David Wallace  
Senate Chair  
Sen. John Payton  
Senate Vice Chair



Rep. Jimmy Gazaway  
House Chair  
Rep. Richard Womack  
House Vice Chair

Roger A. Norman, JD, CPA, CFE, CFF  
Legislative Auditor

## LEGISLATIVE JOINT AUDITING COMMITTEE ARKANSAS LEGISLATIVE AUDIT

### REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING AND ON COMPLIANCE AND OTHER MATTERS BASED ON AN AUDIT OF FINANCIAL STATEMENTS PERFORMED IN ACCORDANCE WITH GOVERNMENT AUDITING STANDARDS

#### INDEPENDENT AUDITOR'S REPORT

Arkansas Soybean Promotion Board  
Legislative Joint Auditing Committee

We have audited, in accordance with auditing standards generally accepted in the United States of America and the standards applicable to financial audits contained in *Government Auditing Standards* issued by the Comptroller General of the United States, the financial statements of the major fund of the Arkansas Soybean Promotion Board (the "Agency"), a board of Arkansas state government, as of and for the year ended June 30, 2023, and the related notes to the financial statements, which collectively comprise the Arkansas Soybean Promotion Board's departmental financial statements, and have issued our report thereon dated October 19, 2023.

#### *Report on Internal Control Over Financial Reporting*

In planning and performing our audit of the financial statements, we considered the Agency's internal control over financial reporting (internal control) as a basis for designing audit procedures that are appropriate in the circumstances for the purpose of expressing our opinion on the financial statements but not for the purpose of expressing an opinion on the effectiveness of the Agency's internal control. Accordingly, we do not express an opinion on the effectiveness of the Agency's internal control.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected, on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies. Given these limitations, during our audit we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, material weaknesses or significant deficiencies may exist that were not identified.

#### *Report on Compliance and Other Matters*

As part of obtaining reasonable assurance about whether the Agency's financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the financial statements. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards*.

***Purpose of this Report***

The purpose of this report is solely to describe the scope of our testing of internal control and compliance, and the results of that testing, and not to provide an opinion on the effectiveness of the entity's internal control or on compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* in considering the entity's internal control and compliance. Accordingly, this communication is not suitable for any other purpose. However, pursuant to Ark. Code Ann. § 10-4-417, all reports presented to the Legislative Joint Auditing Committee are matters of public record, and distribution is not limited.

ARKANSAS LEGISLATIVE AUDIT

A handwritten signature in black ink that reads "Tom Bullington". The signature is written in a cursive style with a long horizontal stroke at the end.

Tom Bullington, CPA  
Deputy Legislative Auditor

Little Rock, Arkansas  
October 19, 2023

**ARKANSAS SOYBEAN PROMOTION BOARD  
BALANCE SHEET – GOVERNMENTAL FUND  
JUNE 30, 2023**

Exhibit A

	<b>General Fund</b>
<b>ASSETS</b>	
Cash and cash equivalents	\$ 9,347,445
Prepaid items	10,000
<b>TOTAL ASSETS</b>	<b>\$ 9,357,445</b>
<b>LIABILITIES AND FUND BALANCE</b>	
<b>Liabilities:</b>	
Accounts payable	\$ 13,304
Due to institutions of higher education	959,956
Due to other governments	33,387
<b>Total Liabilities</b>	<b>1,006,647</b>
<b>Fund balance:</b>	
Nonspendable for prepaid items	10,000
Committed for soybean promotion and research	8,340,798
<b>Total Fund Balance</b>	<b>8,350,798</b>
<b>TOTAL LIABILITIES AND FUND BALANCE</b>	<b>\$ 9,357,445</b>

The accompanying notes are an integral part of these financial statements.

**ARKANSAS SOYBEAN PROMOTION BOARD**  
**STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE –**  
**GOVERNMENTAL FUND**  
**FOR THE YEAR ENDED JUNE 30, 2023**

Exhibit B

	<u>General Fund</u>
<b>REVENUES</b>	
Soybean assessments - first purchasers	\$ 10,218,894
Soybean assessments - other states	444,601
Other income	4,275
Less:	
Remittances to the United Soybean Board	4,947,716
Remittances to other states	433,784
	5,286,270
<b>TOTAL REVENUES</b>	<b>5,286,270</b>
 Less: State Treasury service charge	 317,198
	 4,969,072
<b>NET REVENUES</b>	<b>4,969,072</b>
 <b>EXPENDITURES</b>	
Program expenses:	
Research	1,221,170
Producer communication	282,893
Market promotions	212,619
Consumer information	22,500
Industry information	67,319
Total program expenses	1,806,501
 Administration	 26,645
	1,833,146
<b>TOTAL EXPENDITURES</b>	<b>1,833,146</b>
 <b>NET CHANGE IN FUND BALANCE</b>	 <b>3,135,926</b>
 FUND BALANCE - JULY 1	 5,214,872
 FUND BALANCE - JUNE 30	 <b>\$ 8,350,798</b>

The accompanying notes are an integral part of these financial statements.

**ARKANSAS SOYBEAN PROMOTION BOARD**  
**STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE –**  
**BUDGET AND ACTUAL – GENERAL FUND**  
**FOR THE YEAR ENDED JUNE 30, 2023**

Exhibit C

	Budgeted Amount		Actual	Variance With
	Original	Final		Final Budget Positive (Negative)
<b>REVENUES</b>				
Soybean assessments, net	\$ 10,500,000	\$ 10,500,000	\$ 4,864,797	\$ (5,535,203)
Other income			4,275	4,275
<b>TOTAL REVENUES</b>	<b>10,500,000</b>	<b>10,500,000</b>	<b>4,969,072</b>	<b>(5,530,928)</b>
<b>EXPENDITURES</b>				
Operating expenses	60,500	479,250	266,752	212,498
Professional fees and services	2,000	420,750	237,888	182,862
Grants and aids		7,400,000	1,328,506	6,071,494
Research and development	8,237,500			
<b>TOTAL EXPENDITURES</b>	<b>8,300,000</b>	<b>8,300,000</b>	<b>1,833,146</b>	<b>6,466,854</b>
<b>NET CHANGE IN FUND BALANCE</b>	<b>2,200,000</b>	<b>2,200,000</b>	<b>3,135,926</b>	<b>935,926</b>
<b>FUND BALANCE - JULY 1</b>	<b>5,214,872</b>	<b>5,214,872</b>	<b>5,214,872</b>	
<b>FUND BALANCE - JUNE 30</b>	<b>\$ 7,414,872</b>	<b>\$ 7,414,872</b>	<b>\$ 8,350,798</b>	<b>\$ 935,926</b>

The accompanying notes are an integral part of these financial statements.

**ARKANSAS SOYBEAN PROMOTION BOARD  
NOTES TO FINANCIAL STATEMENTS  
JUNE 30, 2023**

**NOTE 1: Summary of Significant Accounting Policies**

**A. Reporting Entity/History**

The Arkansas Soybean Promotion Board, a board of Arkansas state government, was created by Act 259 of 1971, as amended, to promote the growth and development of the soybean industry in Arkansas through research, extension, promotion, and market development. The Board consists of nine Governor-appointed members, who must all be practical producers of soybeans. Three members represent the Arkansas Farm Bureau Federation, Inc., and two members each represent Riceland Foods, Inc., the Arkansas Soybean Association, and the Agriculture Council of Arkansas.

**B. Basis of Presentation – Fund Accounting**

The accounting system is organized and operated on a fund basis. A fund is defined as a fiscal and accounting entity with a self-balancing set of accounts recording cash and other financial resources, together with all related liabilities and residual equities or balances and changes therein, which are segregated for purposes of carrying on specific activities or attaining certain objectives in accordance with special regulations, restrictions, or limitations. The following types of funds, if applicable to this Agency, are recognized in the accompanying financial statements.

Governmental Funds

General Fund – General Fund is the general operating fund and is used to report all financial resources, except those required to be accounted for in another fund.

**C. Basis of Accounting**

Basis of accounting refers to when revenues and expenditures or expenses are recognized and reported in the financial statements. Financial statements for governmental funds are presented using the current financial resources measurement focus and the modified accrual basis of accounting. Revenues are recognized when they become both measurable and available. "Available" means collectible within the current period or soon enough thereafter to pay current liabilities (i.e., 45 days). Expenditures are generally recognized under the modified accrual basis when the related fund liability is incurred. Revenues from federal grants and federal reimbursements are recognized when all applicable eligibility requirements and the availability criteria of 45 days have been met. Under the accrual basis, revenues are recognized when earned, and expenses are recorded when incurred.

**D. Cash and Cash Equivalents**

Cash and cash equivalents include demand accounts, imprest accounts, cash on hand, cash in State Treasury, all certificates of deposit with maturities at purchase of 90 days or less, and all short-term instruments with maturities at purchase of 90 days or less. All short-term investments are stated at fair value.

**E. Deposits and Investments**

State Board of Finance Policies

Ark. Code Ann. § 19-4-805 requires that agencies holding monies not deposited in the State Treasury, other than the institutions of higher learning, abide by the recommendations of the State Board of Finance. The State Board of Finance promulgated cash management, collateralization, and investments policies and procedures, effective July 14, 2012, as referenced in the Financial Management Guide issued by the Department of Finance and Administration for use by all state agencies.



ARKANSAS SOYBEAN PROMOTION BOARD  
NOTES TO FINANCIAL STATEMENTS  
JUNE 30, 2023

NOTE 1: Summary of Significant Accounting Policies (Continued)

E. Deposits and Investments (Continued)

State Board of Finance Policies (Continued)

The stated goal of state cash management is the protection of principal, while maximizing investment income and minimizing non-interest earning balances. Deposits are to be made within the borders of the State of Arkansas and must qualify for Federal Deposit Insurance Corporation (FDIC) deposit insurance coverage. Policy requires a minimum of four bids to be sought on interest-bearing deposits in order to obtain the highest rate possible.

Policy states that funds are to be in transactional and non-transactional accounts as defined in the Financial Management Guide. Funds in excess of immediate expenditure requirements (excluding minimum balances) should not remain in non-interest bearing accounts.

State Board of Finance policy states that cash funds may only be invested in accounts and investments authorized under Ark. Code Ann. §§ 19-3-510, -518. All noncash investments must be held in safekeeping by a bank or financial institution. In addition, all cash funds on deposit with a bank or financial institution that exceed FDIC deposit insurance coverage must be collateralized. Collateral pledged must be held by an unaffiliated third-party custodian in an amount at least equal to 105% of the cash funds on deposit.

Deposits

Deposits are carried at cost and consist of cash in State Treasury totaling \$9,347,445. State Treasury Management Law governs the management of funds held in the State Treasury, and the Treasurer of State is responsible for ensuring these funds are adequately insured and collateralized.

F. Prepaid Expenses

Prepaid expenses generally represent the cost of consumable supplies on hand or unexpired services at year-end. The cost of these items is included with expenditures at the time of purchase. Prepaid expenses, as reported in the general fund financial statements, are also recorded as a nonspendable component of fund balance indicating that they do not constitute "available, spendable financial resources."

G. Fund Equity

Fund Balance

In the financial statements, fund balance is reported in one of five classifications, where applicable, based on the constraints imposed on the use of the resources.

The nonspendable fund balance includes amounts that cannot be spent because they are either (a) not in spendable form (e.g., prepaid items, inventories, long-term amount of loans and notes receivables, etc.) or (b) legally or contractually required to be maintained intact.

The spendable portion of fund balance, where applicable, comprises the remaining four classifications: restricted, committed, assigned, and unassigned.

*Restricted fund balance.* This classification reflects constraints imposed on resources either (a) externally by creditors, grantors, contributors, or laws or regulations of other governments or (b) by law through constitutional provisions or enabling legislation.

ARKANSAS SOYBEAN PROMOTION BOARD  
NOTES TO FINANCIAL STATEMENTS  
JUNE 30, 2023

NOTE 1: Summary of Significant Accounting Policies (Continued)

G. Fund Equity (Continued)

Fund Balance (Continued)

*Committed fund balance.* These amounts can only be used for specific purposes according to constraints imposed by legislation of the General Assembly, the government's highest level of decision-making authority. Committed amounts cannot be used for any other purpose unless the General Assembly removes or changes the constraint by the same action that imposed the constraint.

*Assigned fund balance.* This classification reflects amounts constrained by the State's "intent" to be used for specific purposes but are neither restricted nor committed. The General Assembly has the authority to assign amounts to be used for specific purposes by legislation or approved methods of financing.

*Unassigned fund balance.* This amount is the residual classification for the general fund.

When more than one spendable classification is available for use, it is the State's policy to use the resources in this order: restricted, committed, assigned, and unassigned.

H. Budgetary Data

The State utilizes an annual budgeting process with budget amounts initially derived from the previous fiscal year's funded allocation. In accordance with the appropriations and funding provided by the Legislature, individual state agencies have been charged with the responsibility of administering and managing their programs as authorized by the Legislature. Agencies are also charged with the responsibility of preparing an annual operations plan as a part of the budgetary process for the operation of each of their assigned programs. State law provides for the establishment of a comprehensive financial management system that includes adequate controls over receipts, expenditures, and balances of Agency funds. It is mandated that this system include a modified accrual system, conform with generally accepted governmental accounting principles, and provide a reporting system whereby actual expenditures are compared to expenditures projected in the Agency's annual operation plan.

**ARKANSAS SOYBEAN PROMOTION BOARD  
NOTES TO FINANCIAL STATEMENTS  
JUNE 30, 2023**

**NOTE 2: Commitments – Approved Contracts and Projects in Process**

At June 30, 2023, the Agency had commitments of \$2,822,911 for approved contracts and projects in process as follows:

Description of Approved Contracts / Projects In-Process	Funds Committed	Cumulative Expended as of 6/30/2023	Balance Remaining 6/30/2023
<b>RESEARCH</b>			
University of Arkansas:			
Research (various)	\$ 2,971,978	\$ 978,046	\$ 1,993,932
Fellowship	<u>375,000</u>	<u>250,000</u>	<u>125,000</u>
<b>TOTAL RESEARCH</b>	<u>3,346,978</u>	<u>1,228,046</u>	<u>2,118,932</u>
<b>INDUSTRY INFORMATION</b>			
Arkansas Soybean Association - 2023 Yield Contest	<u>205,000</u>		<u>205,000</u>
<b>ADMINISTRATION</b>			
Landmark, LLP - Accounting Services	<u>175,000</u>	<u>38,133</u>	<u>136,867</u>
<b>VARIOUS EXPENDITURE CATEGORIES</b>			
The Communications Group - Marketing	<u>2,400,000</u>	<u>2,037,888</u>	<u>362,112</u>
<b>TOTALS - JUNE 30, 2023</b>	<b>(a) <u>\$ 6,126,978</u></b>	<b><u>\$ 3,304,067</u></b>	<b><u>\$ 2,822,911</u></b>

(a) Commitments and research are ongoing, but additional funding must be approved each fiscal year.

**NOTE 3: Subsequent Event**

As a result of Act 712 of 2023, effective July 1, 2023, the Agency was transferred to the Department of Agriculture. Arkansas Farm Bureau continued to assist with the administration of the Agency until July 31, 2023.

**ARKANSAS SOYBEAN PROMOTION BOARD  
SCHEDULE OF EXPENDITURES BY GENERAL LEDGER CODE  
JUNE 30, 2023**

Schedule 1

	<u>General Fund</u>
Travel and subsistence	\$ 11,010
Professional services and fees	237,888
Other expenses and services	8,000
Commodities, materials, and supplies	1,846
Assistance, grants, and aid	<u>1,574,402</u>
<b>TOTAL</b>	<b><u>\$ 1,833,146</u></b>

**ARKANSAS SOYBEAN PROMOTION BOARD**  
**SCHEDULE OF SELECTED INFORMATION**  
**JUNE 30, 2023**  
**(UNAUDITED)**

Schedule 2

	For the Year Ended June 30,				
	2023	2022	2021	2020	2019
<b>General Fund</b>					
<b>Total Assets</b>	\$ 9,357,445	\$ 6,231,580	\$ 4,763,455	\$ 4,246,144	\$ 4,454,715
<b>Total Liabilities</b>	1,006,647	1,016,708	947,222	1,329,104	1,209,857
<b>Total Fund Equity</b>	8,350,798	5,214,872	3,816,233	2,907,040	3,244,858
<b>Net Revenues</b>	4,969,072	4,328,614	3,644,341	2,643,003	2,924,509
<b>Total Expenditures</b>	1,833,146	2,931,082	2,735,235	2,982,428	3,252,056
<b>Total Other Financing Sources (Uses)</b>		1,107	87	1,607	133

# ARKANSAS SOYBEAN PROMOTION BOARD

Interim Communications Report | October – December '23



COMMUNICATIONS GROUP  
POWERING INSIGHT

# OVERVIEW

- Digital and Social Media
- Public Relations
- Relationship Highlights



# Digital and Social Media





# Digital

**3,000 Total Site Visits** (vs. 6,026 in Oct. – Dec. '22)

(1,214 attributed to Arkansas Soybean Month)

**1.5 Pages per Session** (vs. 1.5 in Oct. – Dec. '22)

## Content Accessed:

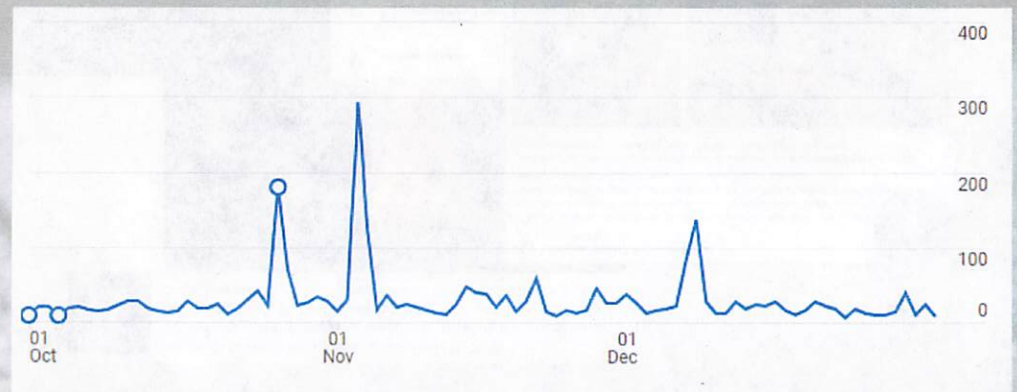
1. Home
2. Arkansas Soybean Month
3. Soy Health Benefits

**Top Sources:** Google/Organic, Direct, Facebook/Social

## Website Updates/Improvements:

- News Releases/Articles/Bean Brief Added to Trending Page
- ASM page updates
- Updated website header imagery/video

TheMiracleBean.com Website Traffic  
Oct. – Dec. 2023



# Social Media *Overview of Facebook, Instagram, X*

91 Total Posts

30 New Followers

62,289 Total Impressions

3,379 Total Engagements

Top Posts Per Platform



Arkansas Soybean @arkansassoybean · Nov 15, 2023  
Defend your #soybeans against nematodes! Dive into the critical research led by @AginArk's Dr. Travis Fiske to discover how you can safeguard your crops. Learn more in this featured research video: [ecs.page.link/IAB7K](https://ecs.page.link/IAB7K)



arkansassoybeans  
Pop the rich history of soybeans for this year's harvest. Keep the economies by raising & #arkansassoybeanmonth #soybeanmonth #arkans #soy



Arkansas Soybean Promotion Board  
October 26, 2023 · 41  
Julie Robinson's journey began on a Greentree family farm, giving her a passion for agriculture. Armed with degrees in agronomy, agricultural economics, and a doctorate in plant pathology, she is now an Associate Professor at the Arkansas Cooperative Extension Service. She now empowers adults through the Lead 48 program. She also guides the minds of high school students in the Soybean Science Challenge, showing the... See more



CAREER SNAPSHOT  
JULIE ROBINSON

1 comment · 13 views



Facebook has consistently been the top-performing platform, with the top three posts being Career Snapshot posts.

# Social Media Highlights



# Digital *Bean Brief*

3,199 Total Sends

1,199 Total Opens

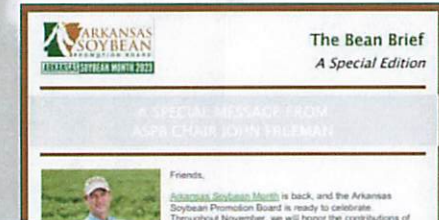
37.77% Open Rate (compared to 23% industry average)

90 Clicks

2.81% Click Rate (compared to 2.94% industry average)

-9 Contact Growth

*\*Due to bounce backs and undeliverables*



# Public Relations



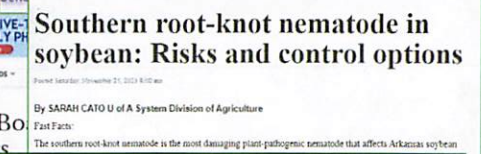
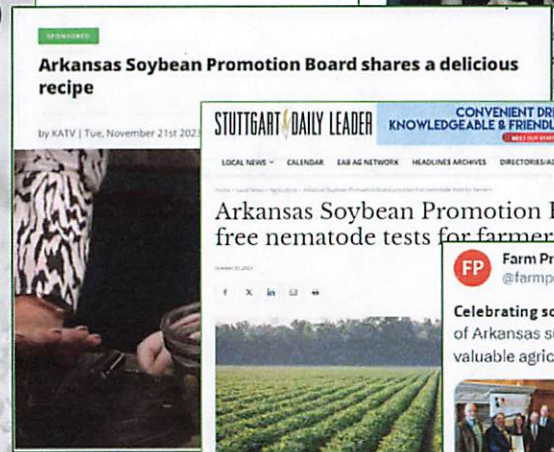
# Public Relations

TOTAL POTENTIAL IMPRESSIONS

# 6,273,843

(5,768,024 impressions attributed to Arkansas Soybean Month)

- 28 Total Stories
- 2 Broadcast (during Arkansas Soybean Month)
- 17 Website
- 5 Social
- 2 Newsletter





ARKANSAS SOYBEAN MONTH 2023

# Public Relations *Arkansas Farm Bureau Convention*

## Objective:

- Provide tradeshow booth and conference support.
- Represent ASPB in the booth.
- Engage and educate booth visitors.

## Impact:

- ComGroup served as an extension of ASPB during the 2 days of the conference.
- ComGroup engaged conference attendees and distributed premium items.
- ComGroup answered questions from conference attendees about topics including 2023 yield data, Grow for the Green results, consumer uses, ASPB board appointments, and the annual report.





# Public Relations *Governor's Proclamation Signing Day*

## Objective:

- Provide onsite support for the Board during the signing day at the Capital.

## Impact:

- ComGroup promoted the Governor's Arkansas Soybean Month signing day across ASPB's digital, social media platforms and newsletter.







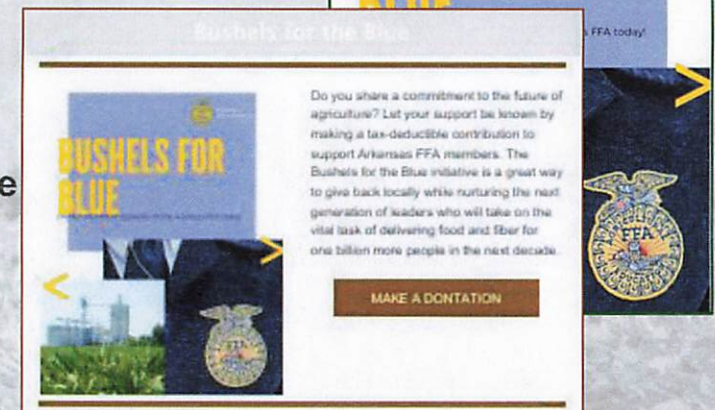
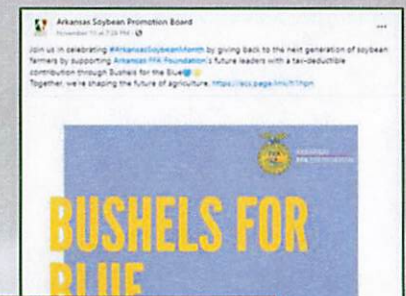
# Public Relations *FFA Partnership*

## Objective:

- Connect with student audience by strengthening the relationship between ASPB and FFA
- Promote FFA's 'Bushels for the Blue' program to help invest in the future leaders of agriculture.

## Impact:

- Through coordination with Arkansas FFA Executive Director Jennifer Cook, FFA and ASPB cross-promoted the Soybean Bushels for the Blue and Arkansas Soybean Month through the Bean Brief and across social media platforms.



# Relationship Highlights 2010-2023



# Relationship Highlights

Marketing and Promotion	
Annual Reports	Compilation of reports showcasing research and accomplishments, aimed at informing stakeholders
Arkansas Soybean Month	Designation and celebration of a dedicated month for the Arkansas soybean industry.
Tradeshow and Conference Exhibit	Development of a branded exhibit for industry events
USB Representation	Representing the Arkansas board at the national level with the United Soybean Board
Multimedia Campaigns	Creation of TV, billboards, radio spots, and print ads to increase brand awareness



# Relationship Highlights *Continued*

Branding and Online Presence	
Establishment of Logo and Branding	Creating a recognizable and distinctive brand identity
Creation of TheMiracleBean.com	Website development to enhance online presence and communication
Social Media Presence	Establishment of profiles on Instagram, Facebook, and X for broader audience engagement
Bean Brief Monthly Newsletter	Regular communication with stakeholders through a newsletter



# Relationship Highlights *Continued*

## Collaborations and Community Engagement

<b>International Visitor Tour (2017)</b>	Coordinating a tour for international visitors to showcase the industry
<b>Arkansas Women Bloggers Influencer Campaign (2017)</b>	Collaborating with influencers to reach a broader audience
<b>Poultry Industry Materials and Campaign</b>	Creation of specialized materials and campaigns for the poultry industry
<b>Unique Partnerships</b>	Development of partnerships and relationships within the Arkansas agricultural community
<b>Active Engagement with Community</b>	Establishing and maintaining active engagement with a diverse community of producers, consumers, researchers, students, and industry stakeholders



# Relationship Highlights *Continued*

Educational Initiatives	
Field to Film Series	Highlighting agriculture career options through a dedicated series
Produced two Arkansas soybean industry documentaries	Educated and celebrated the industry's impact and legacy
Kitchen   Field Table Tour	Implementation of a restaurant program to promote the Arkansas soybean industry



# Relationship Highlights *Continued*

## Media Presence Growth and Recognition

### Media Presence and Brand Awareness

Expansion of media presence and consistent earned media coverage

### Documentaries Celebrating Industry Impact

Production of distinctive documentaries to educate and celebrate the industry's impact





COMMUNICATIONS GROUP  
Marketing | Public Relations  
**POWERING INSIGHT**

Contact: Carson Horn, APR  
[chorn@comgroup.com](mailto:chorn@comgroup.com) | 501-515-0849



**Fall  
Soybean  
Report  
2023**

PI	Table of Content	Page #
	<b>Agronomy/Alternative</b>	
Mike Daniels	Discovery Farm -YR 2/3	1
Jeremy Ross	Investigating Emerging Production Recommendations for Sustainable Soybean Production - YR/New	2
Jeremy Ross	Improving Technology Transfer for Profitable an Sustainable Soybean Production - YR/New	3
Jeremy Ross	On Farm Variable Soybean Seeding Rate Study - YR 3/3	4
Jeremy Ross	Science for Success – Arkansas Support for National Soybean Research and Extension Program - YR/New	5
	<b>Breeding</b>	
John Carlin	Arkansas Soybean Performance Trials - YR/New	6
Caio Canella Vieira	Development of High-yielding Soybean Cultivars with Broad Resilience to Stressors - YR/New	9
Caio Canella Vieira	Utilization of Winter Nursery for Soybean Line Development through Backcrossing - YR 2/3	11
Caio Canella Vieira	Fast-tracking MG4 and early MG5 cultivars with southern root-knot nematode resistance - YR 3/3	12
Caio Canella Vieira	Soybean Germplasm Enhancement Using Genetic Diversity - YR/New	14
Caio Canella Vieira	Genomic Prediction to Enhance the Efficiency of Soybean Breeding - YR/New	16
	<b>Economics</b>	
Brian Deaton	Economic Analysis of Soybean Production and Marketing Practices - YR/New	17
Breana Watkins	Soybean Enterprise Budgets - YR/New	18
	<b>Education</b>	
Julie Robinson	Arkansas Future Ag Leaders Tour - YR 2/3	19

PI	Table of Content	Page #
Julie Robinson	Soybean Science Challenge (SSC)- YR 2/3	20
<b>Entomology</b>		
Ben Thrash	Refining Insect Thresholds in Arkansas Soybean - YR 2/3	21
Ben Thrash	Impact on Water Quality on Insects - YR 3/3	22
Rupesh Kariyat	Developing Scouting, Threshold and Management Practices for Stinkbug - YR/New	23
<b>Fertility</b>		
Trent Roberts	Fertilization of Soybean - YR/New	24
Trent Roberts	Influence of Cover Crops and Soil Health on Soybean - YR/New	25
Trent Roberts	Field Based Determination of Chloride in Soybean - YR/New	26
Trent Roberts	Monitoring the Extent of Potassium Deficiency and Chloride Toxicity in Arkansas Soybean Fields - YR/New	27
<b>Irrigation</b>		
Aurelie Poncet	Characterizing Top to Bottom Soybean Yield Variability in Furrow Irrigated Fields - YR 3/3	28
Chris Henry	Irrigation Water Management for Soybeans: Moving the Needle - YR/New	
<b>Plant Pathology</b>		
Travis Faske	Comprehensive Disease Screening of Soybean Varieties in Arkansas - YR 3/3	30
Travis Faske	Integrated Nematodes in Arkansas - YR/New	31
Travis Faske	Monitor and Management of Fungicide-Resistant Soybean Diseases in Arkansas - YR 2/3	32

PI	Table of Content	Page #
Asela Wijeratne	Development of Mobile App for Detection of Soybean Foliar Diseases - YR/New	
Terry Spurlock	Developing a Satellite-Based Field Scouting Tool - YR/New	33
Terry Spurlock	Determining the Value of Fungicide Application on Regional, Whole-Farm, Field Level, and Within-Field Scales - YR/New	35
Terry Spurlock	Determining Factors, Associated with Poor Grain Quality - YR 2/3	36
Terry Spurlock	Understanding Taproot Decline; A Soybean Disease of Increasing Importance in Arkansas - YR/New	38
<b>Post Harvest</b>		
Beth Kegley	The effects of the inclusion of soybean oil in beef heifer diets on reproductive performance	40
Michael Kidd	Assessment of Broiler Dietary Least Cost Protein Supply via Soybean Genotype Amino Acid Selection Improvements - YR 2/3	41
Ali Ubeyitogullari	An Innovative Approach to Generate Porous Soy Proteins with Enhanced Flavor for the Plant-Based Food Industry - YR/New	50
<b>Verification</b>		
Jeremy Ross	Soybean Research Verification Program - YR/New	51
<b>Weeds</b>		
Tommy Butts	A Team Approach to Weed Management in Soybean - YR/New	53
Jason Norsworthy	Screening for Soybean Tolerance to Metribuzin - YR 2/3	55
Burt Bluhm	Optimization of Fungal Pathogens AF22 and AF24 as Bioherbicides for Palmer Amaranth (Pigweed) - YR/New	56

PI	Table of Content	Page #
B.P. Little john	Use of Gossypol to Inhibit Reproduction in Domestic Hogs as a Model for Feral Hog Control	57

**Arkansas Soybean Research and Promotion Board  
Project Progress Report - Arkansas Discovery Farm  
October 2023  
Submitted by Mike Daniels**

**Summary:** The Arkansas Soybean Research and Promotion Board granted funding to the Arkansas Discovery Farm Program that funds 0.5 FTE of A Discovery Farm technician that collects water, soil and irrigation flow samples throughout the State. The Arkansas Discovery Farm program is currently collecting water quantity and quality data from both inflow from rain and irrigation and in outflow as runoff from five row crop farms, one in Arkansas County near Stuttgart (Corn, rice and soybeans;), one in Desha County near Dumas (4 cotton fields), one in Cross County near Cherry Valley (2 soybean field; 2 rice fields), four fields in Phillips County, 3 fields in Green County and we have added a new farm in Jackson County (three rice fields amended with three different rates of poultry litter on cut ground).

**Discovery Farm Progress:**

During the calendar year 2023 so far, we have collected > 175 runoff samples We continue to build a database on soybean production and runoff water quality and will be working to getting this data published and circulated via fact sheets and websites. In February, we held the first annual Discovery Farm Conference which attracted over 180 people. Several Discovery Farmers spoke on the data collected on their farms. Fifty agricultural students from the College of the Ozarks in Branson Missouri also attended. We also held the joint Anheuser Busch UADA Discovery Farm Field Day at the AB mill near Jonesboro. Over 200 people attended where various speakers on agricultural sustainability and addressing natural resource concerns. Additionally, data collected from Discovery Farms was published in a special Discovery Farm issue of the 2022 Wayne Sabbe Soil Fertility Research Report Series

Publications resulting from Discovery Farm, efforts include:

Daniels, M.B., M. Fryer, N.A. Slaton, A.N. Sharpley, P. Webb, L. Riley, Sam Fernandez, J. Burke, L.G. Berry, T. Roberts and B. Robertson. 2023. Potassium Losses in Runoff from Cotton Production Fields. *Agron. J.* **Volume115, Issue4**. July/August 2023. Pages 1666-1677.

J.M. Burke, M.B. Daniels, P. Webb, A.N. Sharpley, T. Glover, L. Berry, and K. Vandevender. 2023. An Evaluation of Manure Management Strategies, Phosphorus Surface Runoff Potential and Water Usage at an Arkansas Discovery Dairy Farm. *Journal of Environmental Protection*. Vol.14 No.9 2023.

Lebeau, Brye, Daniels, and Wood. 2023. Cover Crop Effects on Infiltration, Aggregate Stability, and Water Retention in the Lower Mississippi River Valley. *Agrosyst. Geosci. Environ.* 25 February 2023. <https://doi.org/10.1002/agg>

**Importance to Soybean Industry:**

As natural resource concerns grow and the agricultural supply chain desires greater documentation of sustainable practices, the Arkansas Discovery Farm program continues to prepare Arkansas farmers to effectively address such concerns and initiatives.

**Title: Investigating Emerging Production Recommendations for Sustainable Soybean Production**

**Lead Investigators: Jeremy Ross**

**Co-Investigators: Ben Thrash**

**Status: New - Continuing**

**Objectives:**

1. Continue to initiate test demonstrations for controlling economically damaging insect pests that often impact the Early Soybean Production System. These pest complexes include Dectes Stem Borer, Grape Colaspis, Thirps, Potato Leaf Hopper, Soybean Looper, and Stink Bug.
2. Evaluate performance of soybean varieties of different herbicide technologies including Liberty Link, LLGT27, Xtend, Enlist, and XtendFlex.
3. Investigate seeding rate and seed treatment interactions of soybean under a wide range of geographic regions and soil textures under different irrigation treatments. Research test will also examine the best replant options for soybean with and without seed treatments.
4. Examine the potential of using new and innovative production factors, and how they influence soybean yields and profitability. Detail research is needed to advise producers in the use of plant growth regulators, alternative fertilizer sources and other soybean production inputs currently not being tested in Arkansas for soybean production sustainability.
5. Soybean N-fixation – Develop a multi-state soybean N-fixation map for characterizing potential responses to N and S management, and for identifying sustainable production systems.
6. The objectives of this project are to: 1) Identify yield response in soybean to biological seed treatments (commonly-marketed products); 2) Conduct economic analyses on the value of these products; and, 3) extend results to soybean growers through extension networks.

**Progress/Accomplishments:**

**Entomology**

We are conducting a study this year in conjunction with the other Midsouth states on the effect time of day has on stinkbug sampling efficiency. Multiple trials on corn earworm, stinkbugs, and soybean looper were conducted during the summer.

**Agronomy**

Research trials were planted between mid-May to early-June at the Jackson County Extension Center (JCEC) and the Pine Tree Research Station (PTRS). Frequent rain prevented planting during May. Early-season measurements and soil samples have been taken, and selected studies have had initial treatments applied. Overall, all studies at the JCEC have good plant stands and good emergence. All treatments have been applied and plots will be harvested when ready. Studies at the PTRS initially had good stands, but all tests have moderate deer damage and water damage due to heavy rainfalls after emergence.

**Title: Improving Technology Transfer for Profitable and Sustainable Soybean Production**

**Lead Investigators: Jeremy Ross**

**Co-Investigators: Jason Norsworthy**

**Status: Year 1 of 3 - Continuing**

**Objectives:**

- 1. To ensure timely development and distribution of the Soybean Update publications as well as update computer assisted variety selection program.**
- 2. To improve the rate of technology transfer and adaption by the implementation of educational programs that impart critical decision-making information at advisory and producer level for improved profitability for sustainable soybean production systems (non-irrigated and irrigated), including the use of weekly electronic soybean reports (e-mail and blog) and timely newsletters such as Arkansas Weekly Soybean Report.**
- 3. Continue to coordinate state and regional meetings to facilitate the latest soybean production updates. These will include the Arkansas Soybean Research Summit, Tri-State Soybean Forum, as well as other events deemed necessary by emerging production problems.**
- 4. To increase the awareness of county extension agents, consultants, agribusiness representatives, concerned producers of the status, direction, and value of current soybean research and Extension efforts.**
- 5. Publication of the Soybean Research Series, which will be an on-line archive of yearly reports of the projects funded by the Arkansas Soybean Promotion Board.**

**Progress/Accomplishments:**

University of Arkansas System Division of Agriculture's Soybean Performance Trials have been planted at eight different locations (Jackson County Extension Center, Lon Mann Cotton Research Station, Northeast Rice Research & Extension Center, Northeast Research & Extension Center, Pine Tree Research Station, Rice Research & Extension Center, Rohwer Research Station, and Vegetable Research Station). Yield data, agronomic data from these trials along with additional varietal information obtained from each seed company will be used to develop the 2023 Soybean Update.

Over 25 articles were submitted for publication in the 2022 Arkansas Soybean Research Studies. Articles for the 2022 Arkansas Soybean Research Studies are being reviewed and are being formatted for publication. The 2022 Arkansas Soybean Research Studies will be completed later this year.

The 2024 Tri-State Soybean Forum will be held in Louisiana. The first planning meeting will be later this summer, and potential topics and sponsorship ideas were discussed.

**Upcoming Actions/Activities:**

Once yield data and other data for the Soybean Update is obtained this fall, the 2023 Soybean Update will be developed and published. Additional publications are being developed with collected data from the past few years.



**Title: On-farm Variable Soybean Seeding Rate Study**

**Lead Investigators: Jeremy Ross**

**Co-Investigators: Aurelie Poncet and Greenway Equipment**

**Status: Year 3 of 3**

**Objectives:**

1. Determine the magnitude of spatial variation in soybean's yield response to seeding rate within commercial soybean fields.
2. Determine if variable rate technology (VRT) could practically be deployed in Arkansas to increase soybean returns.
3. Develop criteria on which VRT prescription might be based.

**Progress/Accomplishments:**

One field was selected for this on-farm trial in Lincoln County. This field was selected due to the variable soil textures within the field. The field was planted on May 25, 2023. Seeding rates ranging between 75-175K seed/acre, with four replications of each seeding rate. Initial sand counts, soil samples, and other data have been collected.

**Upcoming Actions/Activities:**

Additional data will be collected throughout the growing season. At maturity treatment strips will be harvested. Data will be analyzed and presented at County, State, and Regional meeting and publications will be developed to report results from this study.

**Title: Science for Success – Arkansas Support for National Soybean Research and Extension Program**

**Lead Investigators: Jeremy Ross**

**Co-Investigators:**

**Status: Year 1 of 3**

**Objectives: With this project, we will be able to develop and distribute research-based information to soybean farmers in Arkansas and across the U.S. on emerging best management practices (BMP's). We will contribute to the Science for Success program by expanding previously successful efforts with the continued development of soybean BMP's through both the effective summarization of existing data and the generation of new data driven information that will allow soybean farmers to increase revenue and invest in sustainable on-farm practices.**

**Progress/Accomplishment:**

Arkansas is participating in three National protocols during the 2023 growing season. The protocols are 1) Soil health evaluation of long-term rotational studies. These soil samples have been taken from a long-term study at the Lon Mann Cotton Research Station. Plots will be harvested this fall and yields will be reported. 2) 2023 is the second year for the National Biological Study. This study consists of nine biological seed treatments along with an untreated control with six replications of each treatment planted at the Jackson County Extension Center and the Pine Tree Research Station. Initial stand counts, plant samples and soil samples have been taken. 3) 2023 is the first year for the National Fungicide/Desiccant Study. This study is evaluating the use of desiccants at different growth stages to evaluate potential yield loss and quality loss with the use of desiccants. All treatments have been applied and plots will be harvested by mid-October.

**Upcoming Actions/Activities:**

Four Extension publications were developed in August, and final revisions are being done on these publications and they will be published this winter. We are continuing to have monthly virtual meetings to discuss research protocols and production issues.

**Title: Arkansas Soybean Performance Trials****Lead Investigators: John Carlin****Co-Investigators:****Status: Year 1****Objectives:**

1. To evaluate the performance of soybean varieties and breeding lines across eight locations within the State of Arkansas
2. To enable abiotic (chloride and metribuzin) and biotic (disease screening) screening of the varieties by collaborating PIs.

**Progress/Accomplishments:****Milestones:****Prep-to-Planting**

126 soybean varieties (Table 1. Below) were entered in the 2023 Arkansas Soybean Performance Trials, of which 57 were entered in the optional early-planted test, 84 were entered into optional flood tolerance trials.

**Table 1. Soybean varieties entered into 2023 Arkansas Soybean Performance Trials**

AG42XF4	DELTA GROW 48XF42	Integra XF4142S	Progeny P4665XF5	R19-46252	USG 7474XF5
AG43XF2	DELTA GROW 49E30/STS	Integra XF4454S	Progeny P4691XF5	R19C-1001	
AG44XF4	DELTA GROW 49XF85/STS	Integra XF4621S	Progeny P4755XF5	R19C-1012	
AG45XF3	DELTA GROW 52XF22	Integra XF4634S	Progeny P4775E3S	R19C-1035	
AG46XF3	DELTA GROW 53XF95/STS	Integra XF4893S	Progeny P4778XF5	R19C-1081	
AG47XF2	DELTA GROW 55X25	Integra XF4914S	Progeny P4798XF	R19C-2678	
AG47XF4	DELTA GROW 55XF23	NK42-A6E3S	Progeny P4806XF5	R19C-3085	
AG48XF2	DONMARIO DM45F23	NK44-J4XF5	Progeny P4850E3	R19C-3147	
AG48XF3	DONMARIO DM48F33	NK44-Q5E3S	Progeny P4947XF5	R19C-3194	
AG52XF0	Dyna-Gro S42XF93S	NK46-B4XF5	Progeny P4999E3S	Revere 4237XF5	
AG53XF2	Dyna-Gro S46XF31S	NK48-A8XF5	Progeny P5056XF5	Revere 4415XF	
AG56XF2	Dyna-Gro S47XF23S	NK49-C2XF5	Progeny P5441XF	Revere 4526XF5	
Axis 4613XF	Dyna-Gro S49XF43S	NK49-T6E3S	Progeny P5641XF	Revere 4727XF	
Axis 4641XF5	Dyna-Gro S49XF82	NK52-D6E3	Progeny P5751XF	Revere 4731XF	
Axis 4813XF5	Eagle Seed ES4800E3	NK54-J9XF5	R18-10491	Revere 4826XF	
DELTA GROW 44XF75/STS	Eagle Seed ES4875XF	NK56-26XF5	R18-10919	Revere 4925XF5	
DELTA GROW 46E10	Innotech 4233E3S	Pioneer P44A21X	R18C-13665	Revere 4934XF	
DELTA GROW 46E30	Innotech 4545E3S	Pioneer P44A60LX	R19-3941S	Revere 5029XF	
DELTA GROW 46X65/STS	Innotech 4983E3S	Pioneer P45A70LX	R19-39444	Revere 5143E3	
DELTA GROW 46XF54	Innvictis A5003XF	Pioneer P46A20LX	R19-410712	S17-17644	
DELTA GROW 47E20/STS	Innvictis A5813XF	Pioneer P46A90LX	R19-411424	S18-6013	
DELTA GROW 47XF38	Innvictis B4603E	Pioneer P47A64X	R19-424115b	S18-6328	
DELTA GROW 48E59	Innvictis B4903E	Pioneer P48A04LX	R19-42447b	S19-10701	
DELTA GROW 48X45	Innvictis B5013E	Progeny P4604XF5	R19-4593	USG 7461XF5	
DELTA GROW 48XF33/STS	Integra X4660	Progeny P4623XF5	R19-45980	USG 7463XF	

All the field layout, prep work, packing, and test layout was executed in a timely manner and the planting dates for the soybean trials are listed below:

**Table 2. Planting dates by test and location**

<u>Test</u>	<u>Location</u>	<u>Plant Date</u>
Early Planted	Rohwer	13-Apr
Early Planted	Stuttgart	13-Apr
Full Season	Keiser	8-May
Full Season	Kibler	25-May
Full Season	Jonesboro	2-May
Full Season	Marianna	3-May
Full Season	Newport	16-May
Full Season	Pine tree	9-May
Full Season	Rohwer	3-May
Full Season	Stuttgart	25-May
Dryland	Stuttgart	25-May
Flood Screening	Jonesboro	6/21/2023
Flood Screening	Pinetree	6/27/2023
Flood Screening	Stuttgart	6/28/2023

**Maintenance and notetaking**

Soybean plots were walked and maintained through the growing season. Good stands were noted across all locations. Soybeans at NERREC showed symptoms of phytophthora during the growing season after heavy rains. Soybean Water-logging trials were conducted at three locations and each location had observable differences between the control and treatment.

Green-stem has been noted at both NERREC and RREC, plots were terminated with Gramoxone® to facilitate harvest. Notes have been completed at all location except for NEREC and RREC.

**Harvest**

MG 4 soybean plots at Rohwer and Keiser have been harvested. Data will be analyzed after the completion of note taking at NEREC and RREC.

**Upcoming Actions/Activities:**

**Harvest and Data analysis**

Plots will continue to be harvested at maturity. Once analyzed data will be made available in excel on the AAES website within two weeks of harvest. A research series publication will be generated and published at end of year.

CONFIDENTIAL

**Title:** Development of High-yielding Soybean Cultivars with Broad Resilience to Stressors

**Lead Investigators:** Caio Canella Vieira

**Co-Investigators:**

**Status:** Year 1 of 3

**Objectives:** i) Hybridization with purpose based on genetic characterization of parental lines; ii) Aggressive off-season nursery population development; iii) Broad phenotypic and genotypic characterization of breeding lines for biotic and abiotic stressors tolerance; and iv) Selective testing footprint across target environments within the University research stations' network.

**Progress/Accomplishments: October 10, 2023 Season Update:**

Plant development of soybean breeding lines across all breeding stages, including preliminary, finals, and pre-commercial tests, and early generation populations went uneventfully. Breeder's notes and morphological trait evaluation are currently in progress for all research plots located in Marianna, Pine Tree, Rohwer, Stuttgart, DeWitt, Fisk, and Fayetteville, Arkansas. Early maturity plots from all yield trials (MGs 3L and 4E) were harvested during the first week of October in Marianna, Pine Tree, Rohwer, and Stuttgart. Breeder's evaluation and yield trials harvest will continue as the plots reach full physiological maturity.

**2023 Releases:** Foundation seed increase of accepted releases, R18-14502 (MG 4) and R18-14147 (MG 4M) are being grown in Stuttgart, AR (Figure 1). Increases have been periodically evaluated for off-type removal for flower color, pubescence color, height, and maturity. Harvest increases are anticipated towards the end of the month once they reach full physiological maturity and seed availability for commercialization is expected in November 2023.



**Figure 1.** Foundation seed increase of R18-14502 in Stuttgart, AR.

**2023 Progeny Rows:** After visual selection based on uniformity, pod load, and maturity, approximately 900 of 14,310 F<sub>4:5</sub> progeny rows derived from 130 bi-parental populations were selected for harvest in Kibler, AR. Hand harvest and threshing are currently ongoing. Additionally, tissue sampling for a subset of progeny rows (~1,000) was performed, and DNA extraction is currently ongoing. Single plants of the selected progeny rows will be hand-harvested. Lines will be genotyped with the Soy3KSNP Beadchip to investigate the potential of genomic prediction in identifying and selecting superior untested genotypes.

**2023 Crossing Block:** We have conducted a total of 151 crossing combinations with over 13,000 crossing attempts in Fayetteville, AR. Evaluation and hand-harvesting of plots are currently underway. Once true crosses are identified, they will be threshed and sent to an off-season nursery to facilitate rapid generation advancement.

**Upcoming Actions/Activities:**

- Continuing note-taking for multiple agronomic traits, including plant height and maturity.
- Thousands of samples were processed in the laboratory for DNA extraction, and marker-assisted selection for resistance to various diseases, and genome-wide marker genotyping is ongoing.
- The selected progeny rows will undergo post-harvest processing, including evaluation of seed composition for protein, oil, fatty acid, and amino acids profile.
- Cold seed storage is being updated and renovated. This process will facilitate the identification of genotypes in the future and the maintenance of quality and germination.
- 2023 Yield data, breeder's selections, and molecular marker information will be compiled and curated for statistical analysis and advancement selections will occur in November.
- Multiple peer-reviewed scientific publications are ongoing; some have been submitted and are under review, and others are being finalized.

**Title:** Utilization of Winter Nursery for Soybean Line Development through Back-crossing

**Lead Investigators:** Caio Canella Vieira

**Co-Investigators:**

**Status:** Year 1 of 3

**Objectives:** To utilize off-season nurseries to convert MG4 breeding lines into Enlist-E3® or other herbicide technologies to support MG4 variety development.

**Progress/Accomplishments:**

1. Between 16 and 32 BC<sub>2</sub>F<sub>1</sub> seeds belonging to 20 backcross combinations were split into three planting dates (6/28/2023, 7/12/23, and 7/19/23) at a winter nursery in Puerto Rico. Plants received a 2,4 D and glyphosate (Enlist Duo®) application two weeks post-emergence. Between 2 and 8 plants survived the application per backcross combination. Foliar tissue samples were collected from each surviving plant for molecular confirmation. Plants carrying the Enlist trait were used as males and crossed back to their respective recurrent parents with 24 to 81 flowers pollinated per cross.
2. The first generation of E3-converted lines (163) grown in preliminary yield trials in three Arkansas locations with two replications is approaching maturity. Breeder's selection notes were taken across all testing locations, and harvest tags and bags are being prepared. These lines will be moved into 2024 regional trials based on yield potential across multiple environments as well as the presence of genetic resistance for multiple biotic and abiotic stressors. In addition, nine populations (855 E3-converted lines were planted as progeny rows in one Arkansas location the last week of May 2023. Based on satisfactory agronomic traits, an initial set of 70 maturity group (MG) 4-late lines has been selected for evaluation in 2024 preliminary yield trials.

**Upcoming Actions/Activities:**

1. Harvest of BC<sub>3</sub>F<sub>1</sub> seeds by the end of October. Planting of seeds for generation advancement. Rows will receive a 2,4 D and glyphosate (Enlist Duo®) application at the V2-V3 growth stage, and foliar tissue samples from the surviving plants will be collected for molecular confirmation. Plants carrying the Enlist trait will be bulk-harvested per population.
2. Obtain agronomic traits, disease and abiotic stressors tolerance, and yield of E3-converted breeding lines entered in yield trials. Superior genotypes will be aggressively advanced to regional trials in 2024 to speed up the release of the first public Enlist E3 Arkansas soybean variety.
3. An off-season crossing block will be established to develop E3-converted breeding lines with off-target dicamba tolerance through forward crossing.
4. Selected E3-converted breeding lines will be sent to an off-season nursery for seed increase. These will be entered into various regional trials in 2024 to speed up the commercial release by the end of 2024.



**Title:** Fast-tracking MG4 and early MG5 cultivars with Southern root-knot nematode resistance

**Lead Investigators:** Caio Canella Vieira

**Co-Investigators:** Travis Faske

**Status:** Year 2 of 3

**Objectives:** i) Identify soybean cultivars with superior resistance response to SRKN; ii) characterize advanced-stage pre-commercial cultivars within the Arkansas Soybean Breeding Program for reaction to SRKN using molecular markers, greenhouse inoculations, and field screenings; iii) Use cultivars identified in objectives 1 and 2 for the development of new breeding populations to increase the frequency of SRKN resistance in the Arkansas soybean breeding program; iv) Conduct marker-assisted selection for SRKN in the newly developed populations and advance them via winter nursery for fast-track development

**Progress/Accomplishments:** **October 10, 2023 Season Update:** Plant development of soybean breeding lines across all breeding stages, including preliminary, finals, and pre-commercial tests, and early generation populations went uneventfully. Breeder's notes and morphological trait evaluation are currently in progress for all research plots located in Marianna, Pine Tree, Rohwer, Stuttgart, DeWitt, Fisk, and Fayetteville, Arkansas. Early maturity plots from all yield trials (MGs 3L and 4E) were harvested during the first week of October in Marianna, Pine Tree, Rohwer, and Stuttgart. Breeder's evaluation and yield trials harvest will continue as the plots reach full physiological maturity. Genotypically and phenotypically SRKN resistance assessments are ongoing.

R18-10919 and R19C-1081 high-yielding advanced lines were screened for SRKN resistance in 2022 in field and greenhouse conditions and have shown higher levels of resistance. These are reaching physiological maturity across locations and harvesting is underway. In addition, these two lines are being characterized for SRKN resistance based on molecular markers.

**Table 1. Pre-commercial breeding lines with SRKN resistance**

Name	Pedigree	MG	Yield bu/ac	Relative Yield % Check	Galling (0-5)	Root Galling Score (%)
R18-10919	R11-2282/R12-3684	5E	64	85	1.2	3.8
R19C-1081	S09-13635/R11-328:82	4E	63	98	1	11.4

A total of 28 high-yielding advanced pre-commercial lines were screened for southern root-knot nematode under field conditions. The galling score was performed in August by the Lonoke Pathology group. Each entry was planted in eleven-foot, single-row plots, with four replications. Three plants were sampled on Aug. 30 from each plot and rated for percent root system galled. Data has yet to be entered for analysis. Based on other ratings in the field, the 2023 screen was successful, with some susceptible cultivars averaging above 60% root system galled.

**Progeny Rows.** Selection of F<sub>4:5</sub> progeny rows based on pod load, uniformity, and desired agronomic traits is ongoing. Selected materials are currently being hand-harvested, threshed and will be advanced to preliminary yield trials in 2024. In addition, all selected F<sub>4:5</sub> progeny rows will be genotyped for SRKN resistance as well as multiple diseases and abiotic stressors.

**Early Generation and Crossing Block.** Visual selection for pod load, uniformity, and desired agronomic is currently ongoing in 144 EG2 rows in Fayetteville, AR. Selected lines will be hand-harvested using the modified pod pick method in mid-October and advanced to EG3:EG4 generation in an off-season nursery.

We are in the process of manually harvesting approximately 30 to 40 new hybridizations involving the crossbreeding of high-yielding and SRKN-resistant lines in our Summer crossing block located in Fayetteville, AR. Morphological markers will be used to identify true hybrids. Selected materials will be sent to an off-season nursery to expedite generation advancement.

**Collaborative endeavors and Research.** 47 RILs developed by the University of Missouri breeding program are presently advancing in their growth stages in Stuttgart, AR. These RILs are scheduled for combine harvesting towards mid-October. A scientific research paper is currently underway to assess the correlation between SRKN-resistant cultivars regarding nematode populations and their growth cycle. The study aims to investigate the field distribution of nematode juveniles and explore the potential relationship with dicamba-tolerant cultivars.

**Upcoming Actions/Activities:**

- Process phenotypic data from SRKN screening
- Finalize harvesting of F<sub>1</sub> seeds from crossing block
- Finalize harvesting of yield and research plots
- Finalize note-taking of breeder's selection and agronomic traits
- Analyze genotypic data for marker-assisted selection
- Advancement decisions based on multi-environment yield data and SRKN resistance will be conducted in November

**Title:** Soybean Germplasm Enhancement Using Genetic Diversity

**Lead Investigators:** Caio Canella Vieira

**Co-Investigators:**

**Status:** Year 1 of 3

**Objectives:** i) Introduction of novel genetic background from plant introductions (PIs) and elite germplasm from other growing regions to help build a strong and sustainable genetic pool in Arkansas; ii) incorporation of unique economically important traits including grain quality and composition, as well as biotic and abiotic stressors tolerance using various breeding and selection schemes.

**Progress/Accomplishments: October 10, 2023 Season Update:** Plant development of soybean breeding lines across all breeding stages, including preliminary, finals, and pre-commercial tests, and early generation populations went uneventfully. Breeder's notes and morphological trait evaluation are currently in progress for all research plots located in Marianna, Pine Tree, Rohwer, Stuttgart, DeWitt, Fisk, and Fayetteville, Arkansas. Early maturity plots from all yield trials (MGs 3L and 4E) were harvested during the first week of October in Marianna, Pine Tree, Rohwer, and Stuttgart. Breeder's evaluation and yield trials harvest will continue as the plots reach full physiological maturity. Harvesting of F<sub>1</sub> seeds from crossing block is ongoing.

**2023 Releases:** A 1-acre foundation seed increase of R18-14147 is being grown in Stuttgart, AR and seeds will be available for commercialization in November. Increase is reaching physiological maturity and harvesting is expected to take place by the end of October. R18-14147 is a conventional indeterminate, MG 4-M (RM 4.6), high-yielding soybean with high protein (37.5% on a 13% basis) and resistance to stem canker. This cultivar is derived from genetically diversity parental lines and contains novel allelic combinations.

**2023 Pre-commercial:** R19-39444 and R19-39415 (LG13-4321 × R11-7141) are currently being tested in our internal pre-commercial trials and the USDA Uniform Trial (UIV-S-LATE). Pending satisfactory yield performance across multiple environments, these lines may be proposed for release or held for a second year of pre-commercial testing. Pre-commercial lines are currently being harvested and advancement decisions will be made in November.

**2023 Finals:** A total of 21 high-yielding breeding lines derived from exotic parental lines are being tested in 2023 finals yield trials. Final trials are currently being harvested and advancement decisions will be made in November.

**2023 Preliminary:** A total of 300 F<sub>4.5</sub> breeding lines derived from exotic, genetically diverse parents were selected for 2023 preliminary yield trials. Harvest is ongoing and advancement decisions will be made in November.

**2023 Progeny Rows:** A total of 14,310 F<sub>4.5</sub> progeny rows derived from 130 bi-parental populations are being grown in Kibler, Arkansas. Nearly 2,000 rows are derived from genetically diverse parental lines. Approximately 900 F<sub>4.5</sub> progeny rows have been selected to be entered into 2024 Preliminary Trials and are currently being harvested. These will be genotyped with a proprietary molecular marker panel for multiple diseases and abiotic tolerance with Corteva Agriscience, as well as with a genome-wide marker panel for genomic prediction in collaboration with the USDA.

**2023 Crossing Block:** A total of 84 elite parental lines were entered in our crossing block. Many lines derived from other breeding programs carrying economically important traits (biotic and abiotic stressors and seed composition) have been added to diversify and improve Arkansas germplasm. A total of 151 crossing combinations were completed and are currently being harvested. F<sub>1</sub> seeds will be sent to an off-season nursery for generation advancement and will return to Arkansas in 2025 as progeny rows.

**Upcoming Actions/Activities:**

- Note-taking for breeder's selection and multiple agronomic traits including plant height and maturity is nearly completion.
- The harvesting of yield and research plots is ongoing. We are about 50% done with harvesting.
- The harvesting of F<sub>1</sub> seeds from crossing block is ongoing. We are about 70% done.
- Genotyping of 1,100 breeding lines have been completed. Data is currently being curated and processed.
- Genotyping of 1,100 breeding lines with Corteva Agriscience is ongoing and results should be back in 3-4 weeks.
- DNA extraction of 1,000 F<sub>4:5</sub> progeny rows is ongoing and genotyping is expected to take place in January 2024.
- A comprehensive analysis of the genetic diversity of Arkansas germplasm based on high-density molecular data is ongoing. The goal is to understand clusters of genotypes based on genetic similarities and compare them to the USDA Soybean Germplasm Collection materials between MG 4 and 5. This will allow us to calculate the genetic distance between our materials and other germplasms available, and then precisely identify which genotypes would be beneficial to combine with our genetic pool.

**Title:** Genomic Prediction to Enhance the Efficiency of Soybean Breeding

**Lead Investigators:** Caio Canella Vieira

**Co-Investigators:** Samuel Fernandes

**Status:** Year 1 of 3

**Objectives:** i) Establishment of a well-curated training set based on historical multi-environment data from the UARK Soybean Breeding program to develop and validate prediction models; ii) Development of prediction models to be implemented early in the breeding pipeline to select promising genotypes.

**Progress/Accomplishments:** To fulfill the first objective of this project (establishment of a training set to develop and validate prediction models), nearly 1,100 soybean breeding lines across multiple stages of our breeding pipeline (preliminary, finals, and pre-commercial) have been genotyped with the Soy3KSNP Beadchip in collaboration with the USDA Soybean Genomics and Improvement Laboratory led by Dr. Qijian Song. In addition to genotypic data, breeding lines will have yield data from multiple environments in 2022 (finals and pre-commercial) and 2023 (all). Harvest of yield plots is ongoing and is expected to be completed by the 3<sup>rd</sup> week of October.

To fulfill the second objective of this project (development of prediction models to be implemented early in the breeding pipeline to select promising genotypes), nearly 1,000 F<sub>4:5</sub> progeny rows were leaf sampled, and DNA extraction and genotyping are ongoing. As described in the proposal, the major goal of this project is to reduce subjectiveness and prioritize data-driven breeding decisions. Therefore, the yield of these progeny rows will be predicted based on genomic-based models and validated with actual yield trials in the following years.

**Upcoming Actions/Activities:**

- DNA extraction of F<sub>4:5</sub> progeny rows is ongoing and genotyping is expected to be started by January 2024.
- Genotypic data from 1,100 breeding lines have been generated and are currently being curated for further genomic analysis.
- Both progeny rows and breeding lines are also being genotyped utilizing a proprietary molecular marker panel from Corteva Agriscience that indicates the presence of resistance alleles to multiple diseases and abiotic stressors.
- Various applications of genomic prediction including genomic-assisted hybridization design, sparse testing, and different prediction models are under development.

**Title:** Economic Analysis of Soybean Production and Marketing Practices  
**Lead Investigators:** Dr. Brian Deaton, Associate Professor  
**Co-Investigators:**  
**Status:** Active  
**Objectives:** Overall objective is to provide an economic analysis for proposed projects and other SPB funded projects that would benefit from economic analysis. Specific objectives are:  
A. Conduct an economic analysis of production practices used in the Arkansas Soybean Research Verification Program that impact profitability and verify Extension recommendations.  
B. Standardize the economic analysis by integrating the 2022 verification data with data from previous years and make comparisons with SRVP results in adjoining states and throughout the Mid-South. This will continue to document the long-term benefits of the Arkansas Soybean Research Verification Program.  
C. Provide economic assistance and interpretation of agronomic results for projects previously funded or proposed for funding by SPB.

**Progress/Accomplishments:**

A. The economic analysis process for the 2023 ASRVP is ongoing. Data is being gathered for the fifteen fields that are in production. This data includes soybean varieties, herbicides, insecticides, fungicides, fertilizers, and additives/adjuvants. We are waiting on harvest and to receive final field data from the verification coordinators.

Arkansas soybean market price data is continuing to be collected, processed, analyzed, and distributed weekly via the Arkansas Row Crops blog.

B. Dr. Bob Stark is working with me this year. Dr. Stark maintains a historical database that extends back to 1983. He has merged the 2022 verification data into the database and is performing an analysis.

C. Yet to be determined

**Upcoming Actions/Activities:**

- Record yield and remaining input data as the SRVP coordinators disseminate it.
- Gather price data for input prices.
- Arkansas soybean weekly market price reports containing both cash market and new crop booking prices will continue to be published on the “Row Crops Blog” online newsletter throughout the remainder of the year.

**Title: Crop Enterprise Budgets and Production Economics Analysis**

**Lead Investigators: Breana Watkins, Instructor**

**Co-Investigators: Dr. Vic Ford, Associate Director – Ag and Natural Resources**

**Status: Year 2 of 3**

**Objectives: The goal of this project is to provide soybean enterprise budgets that are easily adaptable and allow for evaluation of costs and returns associated with production.**

**Progress/Accomplishments:**

The 2024 crop enterprise budget system is in the final stages of development. The most recent update will include an updated look for the website, pricing sheets for determining custom costs with ease, and new budget definitions to clarify existing terms utilized. There are a total of 24 soybean enterprise budgets differing by seed technology and irrigation type. Tools for evaluating the 2023 research verification trials have been distributed for economists to utilize in the upcoming months.

**Upcoming Actions/Activities:**

The crop enterprise budgets are currently being updated to better serve producers and will be released for 2024 planning in upcoming weeks. This update will include a new website to access the budgets ([farmplanning.uada.edu](http://farmplanning.uada.edu)) as well as a budget calculator and irrigation cost estimator. Cost/benefit analysis of conservation practices in Arkansas is underway. The benefits provided by the economic analysis of alternative soybean production methods provide a significant reduction in financial risk inherent in agricultural production. The current volatility faced in our input supply chains and lack of available replacements will make budgeting important in the upcoming crop seasons. Growing soybeans, being a lower input cost crop, has become increasingly attractive to producers. Flexible crop enterprise budgets are beneficial for planning production methods to provide greatest potential for financial success. The crop enterprise budgets allow economists to create impact statements useful for policy makers and shareholders when showing the importance of assistance for producers in Arkansas in times of dire need. A new layout and clarification in word usage for the budgets will be available in the 2024 crop budget release.

**Title: Arkansas Future Ag Leaders Tour**

**Lead Investigators: Julie Robinson**

**Co-Investigators: Jeremy Ross**

**Status: Ongoing**

**Objectives:**

- Increase participant's employability in agricultural careers.
- Acquaint participants with the vast resources, market segments, and services available through Arkansas' number one industry.
- Provide participants with a "bird's eye view" of current employment opportunities in the Arkansas agriculture industry.
- Increase student's options and opportunities by networking with future employers.

During the week of May 15 – 19, 2023 twelve Arkansas college juniors and seniors participated in the Arkansas Future Ag Leaders Tour. Students enrolled at five (5) Arkansas institutions and three out-of-state institutions (Ohio, Oklahoma, and Texas) participated, including the following institutions:

**In-State Institutions:**

- Southern Arkansas University
- Arkansas State University – Beebe
- Arkansas State University – Jonesboro
- University of Arkansas – Fayetteville
- University of Central Arkansas

**Out-of-State Institutions:**

- Central State University (Ohio)
- Oklahoma State University
- Texas A&M University – Commerce

**Majors of tour participants included:**

- |                         |  |
|-------------------------|--|
| • Agriculture Education | • Sustainable Agriculture and Food Systems |
| • Animal Science        | • Family and Consumer Science              |
| • Agriculture Business  | • Plant and Soil Science                   |

The five-day professional development opportunity included professionalism skills and team building to kick off the week on Monday, May 15. On Tuesday, May 16 participants loaded up on a tour bus to travel across the state and visit or hear from representatives from many areas of the agriculture industry, including:

- |                               |                                      |
|-------------------------------|--------------------------------------|
| • Plyler Farms                | • Anheuser-Busch                     |
| • Farmer's and Merchants Bank | • Woodruff County Electric Coop      |
| • Farm Credit                 | • Arkansas Electric Cooperatives     |
| • Arkansas Farm Bureau        | • Keo Fish Farms                     |
| • RiceTech                    | • Riceland                           |
| • National Ag Law Center      | • Dabbs Farm, Stuttgart              |
| • Peco Foods                  | • JACO Meats                         |
| • Greenway Equipment          | • JA Farms and Feed                  |
| • Daniel-Rowe Farm            | • Arkansas Department of Agriculture |
| • NRCS                        | • Evergreen Packing                  |



**Title:** Soybean Science Challenge

**Lead Investigators:** Julie Robinson

**Co-Investigators:** Jeremy Ross

**Status:** Ongoing

**Objectives:**

1. Develop and deliver original educational resources/curriculum to Arkansas junior high and high school students.
2. Increase awareness and knowledge of the value of soybeans to the Arkansas economy and potential careers supporting Agricultural sustainability among Arkansas junior high and high-school students.
3. Increase knowledge of the diversity of soy products and uses among Arkansas junior high and high-school students.
4. Increase participation in applied research by Arkansas junior high and high-school students supporting soybean production.
5. Development of state-wide educational partnerships to leverage ASPB resources.
6. Actively engage students in the "co-creation" of knowledge and reward outstanding student researchers through the Soybean Science Challenge research awards.
7. Reach out to science teachers to consider using Soybean Science Challenge online education resources and curriculum in their classroom.

**Progress/Accomplishments:**

- The Soybean Science Challenge online course, in-service course, and SSC resources have been updated for accessibility.
- The SSC produced a 12-minute impact video to show the importance of our program to our local schools: [https://youtu.be/-l\\_2Oh\\_MnWs](https://youtu.be/-l_2Oh_MnWs)
- 121 students and teachers have enrolled in the online SSC course to date. Ninety percent (90%) of the students and teachers enrolled have completed the course.
- Community Gardens – over 160 gardens across the nation have Arkansas soybean seeds growing in them.
- The SSC will be doing an 'overhaul' of the online course to make it more streamlined and up to date.
- All lessons have been updated for correct hyperlinks, and some new lessons have been started to cover more science areas.

**Upcoming Actions/Activities:**

- At this time, the SSC will sponsor and will facilitate a workshop at the Arkansas Science Teachers Association Conference in October.
- The SSC will participate the STEM Festival on Friday, October 20. The STEM Festival is a feature leading up to the Little Rock Air Force Base Thunder over the Rock Air Show. K-12 students from across the state are invited to attend. It is estimated that attendance will exceed 2,000 students. Based on the STEM Festival attendance and SSC's experience with the festival in 2019, the estimated numbers are accurate.

**Title:** Refining Insect thresholds in Arkansas soybean

**Lead Investigators:** Ben Thrash

**Co-Investigators:** Nick Bateman, Glenn Studebaker

**Status:** Year 2 of 3

**Objectives:**

**Objective 1.** Verify/refine thresholds for corn earworm, soybean looper, and the stink bug complex in Arkansas soybean

**Objective 2.** Evaluate slug control methods for efficacy and cost effectiveness in Arkansas soybean.

**Objective 3.** Determine the more efficient sampling methods for wide row, narrow row, and drilled soybean for multiple pests.

**Progress/Accomplishments:**

**Objective 1**

Several corn earworm, soybean looper, and stink bug trials were conducted this year in soybean. Trials are currently being harvested/ awaiting harvest.

**Objective 2**

Due to the drought this year a suitable population of slugs could not be found.

**Objective 3**

Two locations of wide and narrow row soybean have been planted and insect numbers will be compared between the two row spacings to determine the difference in insects caught in sweep nets.

Dr. Spurlock has used his drone to record defoliation in looper plots at Marianna. We will use this data to evaluate if this is a suitable method to estimate defoliation percentages in lodged fields of soybean. Data from the drone will be correlated to defoliation estimates made on the ground and then back to yields.

**Title:** Impact of Water Quality on Insecticide Applications in Soybean

**Lead Investigators:** Ben Thrash

**Co-Investigators:** Nick Bateman, Glenn Studebaker

**Status:** Year 3 of 3

**Objectives:**

**Objective 1.** Biopesticides, particularly the viruses, appear to be an alternative to traditional insecticides. In the last two years Heliothis NPV has proven to be very effective for many growers for control of bollworms in soybean. However, there remains much to be learned about the use of these products particularly the effect of water quality on control, tank mixing with other products, and developing sound recommendations for water conditioners. Conducting on-farm trials to determine level of control in high pH water with and without water conditioners and the impact of tankmixing will help us in developing a data set to help us make recommendations on use will be important.

**Objective 2.** Foliar insecticide applications, with different water quality measures will be compared as well as water conditioning agents to combat issues with high pH and or "hardness" (level of solids in water) will be compared to determine if insect control can be improved with additives.

**Objective 3.** Determine the impact of time on insecticides in solution for extended periods of time. In extreme situations where insecticide in the tank in water that has a high pH or high levels of solids for 12, 24 or 48 hours.

**Progress/Accomplishments:**

My student, Taylor Harris, is in the process of analyzing data and finishing her thesis.

## Soybean Promotion Board- 2023 October update

### **Title: Developing scouting, threshold, and management practices for stinkbug complex (Red banded, Green, and Brown) in Arkansas soybean**

Investigators: Drs. Rupesh Kariyat, Neelendra Joshi, Glen Studebaker, Ben Thrash and Nick Bateman

Production System: Soybean

Status: Stated Goal New Proposal Year 1

#### **Objectives:**

- 1:** Develop and update scouting methodology and economic thresholds for the soybean stinkbug complex (Red banded, Green, and Brown)
- 2:** Develop soybean growth stage injury standards across commonly grown soybean varieties for the stinkbug complex.
- 3:** Estimate host plant resistance traits and their variation across soybean varieties for the three stinkbug species under laboratory conditions
- 4:** Evaluate the nutritional quality loss due to stinkbug complex infestation on soybean pods.

#### **Progress/Accomplishments (October update):**

As a part of Objective 1, we conducted a comprehensive survey of soybean plots located at the University of Arkansas farm from mid-August-October first week. The mean abundance of green stink bug measured in terms of sweep net sampling was 1.6 per linear foot of row in late August and increased considerably later in the season, when the abundance was 2.4 stink bugs per linear foot. To determine the species composition, we collected stink bugs with sweep nets and then identified those samples in the laboratory. In this survey, Southern green stink bug was found to be the most dominant species with 96.8% of total stink bugs collected. The proportional abundance of the brown marmorated stink bugs were very low (3.2%). We haven't found any redbanded stink bugs so far in our sampling. We plan to conduct one more week of sampling before the harvest.

As a part of objective 3 and 4 we have grown 18 soybean accessions in the greenhouse and evaluated their resistance and growth traits. As the first line of defense, soybeans employ leaf trichomes. We have developed a microscope-based density assessment and found that regardless of the accessions, fast wilting genotypes had a higher number of trichomes, and leaf underside (abaxial) had higher trichome density. The trichome pictures are below (light and scanning electron microscopy based). In addition, we also followed up these experiments with Southern green stink bugs collected from AES Farm in Fayetteville. We are currently estimating the effects of stink bug damage on defense and growth traits. Detailed results will be presented in annual report.



Figures 1,2,3:  
Trichomes in  
soybean (1,2) and  
Southern green  
Stinkbug feeding  
assay in lab.

**Title: Fertilization of Soybean****Lead Investigators: Trenton Roberts****Co-Investigators: Jeremy Ross****Status: Year 1****Objectives:**

1. Continue long-term P and K fertilizer rate trials established at the Pine Tree Research Station in 2000 (PTRS) and Rice Research Experiment Station in 2007 (RREC) to examine soil-test trends and crop yield responses to fertilization rates.
2. Continue to evaluate existing and develop new correlation calibration relationships between soil-test P (or K) alone and soybean yield and leaf nutrient concentration in response to P (or K) fertilization.
3. Evaluate novel remote sensing platforms using unmanned aerial vehicles to detect hidden hunger and potential K deficiencies before visible symptoms occur.
4. Determine field scale variability in tissue K concentrations and develop sampling protocols for in-season assessment of K nutritional status in soybean.

**Progress/Accomplishments:** During this growing season we are focused on gathering more data related to calibration of the in-season potassium applications needed when either a deficiency or hidden hunger has been identified. Currently, we have five field trials located at the NERREC and PTRS experiment stations over a range of soil test K values but mostly in the very low or low soil test K category. Our goal was to try and place these trials in situations and on soils where we might expect the biggest yield response to in-season K applications. Following last season, we had a critical mass of data that allowed us to start looking at the potential rates of in-season potash that would be required to regain yield potential for a given tissue-K concentration and growth stage combination. It does appear that in more extreme cases when soybean tissue-K is very low that, it might be beneficial to apply more than 100 lb potash/acre. Drone images are also being collected from the trials to determine if there are remote sensing options to help identify potassium deficiency as a surrogate for traditional tissue testing. This work will also encompass sampling from the long-term K trials at Stuttgart and Pinetree. All the trials are at or near maturity and we have begun harvesting sites at NERREC and PTRS. Current yield estimates suggest that the trials will yield well with yields from the "optimal" K rates ranging from 75-85 bushels/acre. The leaf samples that were collected throughout the course of the growing season have been dried, ground and we have received the data from the lab. All four of the K response trials associated with the in-season calibration of K rates based on tissue analysis exhibited some degree of K deficiency during the season suggesting that we should get a significant response to in-season K fertilization. The focal point of this work with tissue testing, specifically for K, is to identify hidden hunger that may be robbing soybean yield as well as calibrate the K fertilizer rates required to recover yield at a given growth stage and K deficiency level combination.

**Upcoming Actions/Activities:** Once the yield data has been collected from all of the sites, we will begin statistical analysis to confirm the degree of response to in-season K fertilization and add this data to the previous year's results. At the conclusion of this season, we should have a good idea of whether or not the in-season tissue samples can be used to guide fertilization rate and what rates are needed to maximize yield at a given number of days following R1.

**Title: Influence of Cover Crops and Soil Health on Soybean****Lead Investigators: Trenton Roberts****Co-Investigators: Jeremy Ross****Status: Year 1****Objectives:**

1. Determine how implementing winter cover crops into a corn-soybean rotation influences N fertilizer needs for corn and N use efficiency.
2. Identify how winter cover crop species influences corn and soybean yield performance and soil physical characteristics related to water holding capacity and irrigation.
3. Monitor soil physical and chemical parameters related to soil health and productivity as influenced by a corn and soybean rotation with varying winter cover crop species.

**Progress/Accomplishments:** Dr. Ross and I are currently participating in a national soil health project related to soybean production. The project includes several states and multiple research locations where either cover crops or other conservation practices have been implemented to assess the impacts on soil health and soybean performance. In Arkansas we were able to include the three long-term continuous no-till cover crop studies as well as the long-term continuous no-till corn soybean rotation study. During the spring and early summer, a total of 940 unique soil samples were taken from these research plots near cover crop termination and soybean planting to assess overall soil health score, soil water holding capacity, carbon retention and quality, microbial activity, and many other factors. These soils were collected, dried, and submitted to the lab for analysis. We are expecting to receive all the results from the lab in mid- to late- October. Trials are currently being harvested and we plan to establish the winter cover crops within the next week. Within the long-term corn/soybean cover crop trial at the PTRS location the soybean were grown with only 2 irrigations during the entire season and initial reports suggest that yields will be very good. There are currently no major issues to report with any of the trials and we are looking forward to the yield data and soil analysis once it becomes available.

**Upcoming Actions/Activities:** Once the yield data and soil analysis are available, we will begin statistical analysis of the data to determine if there are any meaningful changes in soil health metrics since the initiation of the trial. Additionally, we will begin to investigate the relationship between soil health metrics and soybean yield potential.

**Title: Field-based determination of chloride tolerance in soybean****Lead Investigators: Trenton Roberts****Co-Investigators: Jeremy Ross and John Carlin****Status: New- Ongoing****Objectives:**

1. Implement a field-based leaf sampling protocol for rating soybean varieties as an includer or excluder.
2. Provide annual evaluation of soybean cultivar reaction to chloride both as a categorical response of includer, excluder and mixed as well as a numerical rating system that indicate the relative degree of chloride tolerance amongst varieties.
3. Rate the degree of mixed reaction soybean populations so that producers can make informed cultivar selections that best fit their production systems and desired soybean characteristics.

**Progress/Accomplishments:** The field-based determination of chloride tolerance project relies on the soybean Official Variety Trial (OVT) as the foundational source of data. Our methods require us to sample the entries in the soybean OVT to determine the variations in chloride tolerance amongst new and recently released soybean cultivars. Previous research has indicated that the OVT located at the Rohwer Research Station provides the highest levels and greatest separation of tissue chloride concentrations. The OVT that we will sample was planted on May 3, 2023, emerged on May 9, 2023 and has an optimal stand. There are currently 134 entries in the trial and run the gamut from early IV's to late V's and a wide array of herbicide traits. Most of the entries are found in the maturity group IV section (Early 4- 26 and Late 4- 73). All plant leaf samples were collected when the soybean (within individual maturity groups) reached the R4 growth stage. Leaf samples have been dried and ground and are awaiting analysis by the University of Arkansas Diagnostic Lab in Fayetteville, AR.

**Upcoming Actions/Activities:** Once the chloride analysis is complete, we will conduct our statistical analysis to determine the relative chloride tolerance of each cultivar within the OVT. Following the classification, a report will be provided to Variety Testing as well as Dr. Jeremy Ross. Work will begin on writing the Soybean Research Series article for submission in the Spring of 2024.

**Title: Potassium and Chloride Field Monitoring****Lead Investigators: Trenton Roberts and Jeremy Ross****Co-Investigators: Gerson Drescher****Status: Year 1****Objectives:**

1. Identify the magnitude and extent of potassium deficiency, including hidden hunger, across a wide range of Arkansas soybean production systems and estimate the associated yield loss.
2. Identify the magnitude and extent of chloride toxicity across a wide range of Arkansas soybean production systems and estimate the associated yield loss.

**Progress/Accomplishments:** During the spring we conducted two informational meetings for county agents to learn about how to participate in the monitoring program. Our goal was to provide each county with at least the opportunity to sample 1-2 fields and include them within this monitoring project. Initially we had 16 different counties that requested to sample ~50 fields and include in the program. To date we have 10 counties that have sent in a total of 24 fields. Each of the fields within the program were sampled twice, once at the R2 growth stage and then again at the R4 growth stage. Of the samples that have been submitted it appears that most producers who are proactive with their fertility programs have optimal tissue nutrient concentrations and the producers that are not proactive have one or more nutrients that are borderline or severely deficient. The primary nutrients that appear to be deficient are K and B. In many cases the B is borderline to very deficient and the K is low enough to result in anywhere from a 10-15% yield loss. Of all the samples submitted so far there have only been 4 where the Cl levels appeared to be an issue. An interesting finding of this work has been a drop in tissue Cl concentrations between the R2 and R4 sampling dates. Several of the R2 tissue samples that had elevated Cl tissue concentrations had dropped significantly when they were resampled at the R4 growth stage. This information suggests that proper sampling time to estimate Cl toxicity will be as crucial as the sampling window for monitoring K or other nutrient deficiencies. This work has also shown that many producers are unaware of the Cl tolerance ratings for the soybean cultivars they are planting or that the companies do not provide that information for many of them. Early observations also indicate that samples can be collected, submitted and the data in hand within a week in most cases.

**Upcoming Actions/Activities:** Once all of the samples and field data has been collected, we will start compiling a report and data map that will help to show potential areas of the state where either K or Cl may be limiting soybean yields. The results of this season will be used to help guide areas of the state to collect samples next season. The results of this season appear to be targeted towards producers that are very proactive with their nutrient management and next season we will be intentionally seeking out fields with marginal or poor fertility.



**Title:** Characterizing top-to-bottom soybean yield variability in furrow irrigated fields.

**Lead Investigators:** Aurelie Poncet

**Co-Investigators:** Jeremy Ross, Mike Hamilton

**Status:** Year 3 of 3

**Objectives:**

1. Quantify top-to-bottom soybean yield variability in two cropping systems in Arkansas.
2. Identify the drivers of top-to-bottom yield variability in the selected fields.
3. Compare the performance of different plant health metrics for in-season monitoring of the emergence and intensity of top-to-bottom yield-limiting stress.

**Progress/Accomplishments:**

- We established two experimental trials in the Spring:
  - Field A (approx. 25 ac) is located at the Pine Tree Research Station (St. Francis Co.)
  - Field B (approx. 120 ac) is located on-farm near Gould, AR (Lincoln Co.)
- The irrigation furrows were established too late during the growing season for data collection in field B and this site was not considered for this project. Four treatments based on different irrigation triggers were established in field A. Irrigation was applied when the water potential went below -40, -60, and -100 kPa within treatments 1, 2, and 3, respectively. Treatment 4 was not irrigated. Irrigation was applied in-furrow using separate polypipes between treatments. The average furrow length was 780 ft. When a treatment reached the irrigation trigger, water was applied until it reached the bottom of the treatment/furrows. Irrigation was first applied at R1, and will be applied until R7.
- Volumetric soil water content and soil temperature data have been collected using time-domain reflectometry sensors since 06/05/2023 (growth stage: VE). Three sets of four sensors were placed along the furrow to measure soil water dynamics at 210, 390, and 570 ft from the polypipe in the middle of each treatment. The sensor depths were 6, 12, 18, and 36". The data were collected every 15 min using data loggers. Sensors will be removed at R8. Crop is currently at R6.
- Sentinel-2 (approximately 30 ft resolution multispectral satellite imagery) and Landsat 8 (approximately 90 ft resolution multispectral satellite imagery) were acquired from planting to harvest. Satellite return time (temporal resolution) is 5 days for Sentinel 2, and 16 days for Landsat 8.
- RGB, multispectral, and thermal imagery were collected at V5 (before irrigation) and R3 (after irrigation). Images were stitched using Pix4D Mapper Software.

**Upcoming Actions/Activities:**

- Yield will be collected across 4 consecutive crop rows along 8 transects within each treatment using a plot combine. Harvest weights will be collected every 50 ft and adjusted at 13.3% moisture.
- 2 poster presentations and 1 oral presentation will be given at the 2023 ASA-Annual International Meeting on Oct 28-Nov 1.

- **Request data from Soybean Verification Program to compare the yield variability observed in our trials to the amount of variability found in production fields managed using UADA recommendations. That data will also be used to compare the magnitude of yield variability observed across furrows in addition to the amount of variability observed within furrows.**
  
- **Statistical analysis is being computed to:**
  - **Identify the drivers of yield variability in both trials. Treatment effects, distance to polypipe, soil properties described by soil mapping units, soil water content, and soil hydrology characterized from the collected digital elevation models are all considered predictors of yield variability between and within treatments → a manuscript will be submitted for publication consideration by the Agronomy Journal (ASA's flagship journal)**
  - **Determine how early these effects can be detected using drone and satellite imagery. Develop a crop water stress index that can be used to monitor yield variability in Arkansas soybean using satellite or drone imagery, and that can be used to predict what the drivers of that variability may be.**
  - **Compare the data collected in our trials to the information available from the soybean verification program.**
  - **Use process-based modeling to test a few different what-if scenarios and further our understanding of the collected data. Process-based models also represent the transition step from descriptive modeling to predictive (and ultimately prescriptive) models.**

<b>Title</b>	Comprehensive Disease Screening of Soybean Varieties in Arkansas
<b>Lead Investigator</b>	Travis Faske
<b>Co-Investigator(s)</b>	Terry Spurlock, Asia Kud, Michael Emerson, Amanda Tolbert, and John Barham
<b>Status</b>	Continuous, renewed annually
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. Screen all entries in the University of Arkansas Official Variety Testing (OVT) program for frogeye leaf spot (Faske).</li> <li>2. Screen all entries for southern stem canker (Spurlock).</li> <li>3. Screen all entries for southern root-knot at the SWREC (Greer/Barham) and field (Emerson/Faske).</li> <li>4. Provide complete package of screening information to Jeremy Ross and other CES personnel by mid-November (All).</li> </ol>

**Progress/Accomplishments:**

1. All 137 OVT entries were planted in 1-row, 11-ft long, replicated plots on May 23 for frogeye leaf spot screen in a farmer's field near Kerr. All plots were rated in August for susceptibility to FLS. Ratings ranged from 0 to 6, which indicates a good screen for FLS. .
2. All 137 OVT entries were planted in 2-row, 20-ft long, replicated plots spaced 38" apart on June 29/30 for stem canker screening at Rohwer Research Station in Kelso. Varieties were randomized within herbicide trait and maturity group for management, inoculation, and disease data collection considerations (MG 4.2 – 4.6, MG 4.7 – 4.8, MG 4.9 – 5.1, and MG 5.2 – 5.4). For stem canker screening, ten plants per plot were inoculated with the stem canker pathogen, *Phomopsis aspalathi*, using infested toothpicks on August 15th and 16th. The plots will be rated for stem canker and other foliar diseases in mid-October prior to maturity.
3. SRKN
  - a. The southern root-knot nematode screen in the greenhouse was completed in September at SWREC. Because of summer heat, several plants in the third rep died.
  - b. Field performance of OVT against southern root-knot nematode were planted in 1-row, 11-ft long plots replicated four times on May 23 in field with a history of southern root-knot nematode near Kerr, AR. Three plants from each plot were rated in August for susceptibility to the nematode.

**Upcoming Actions/Activities:**

1. FLS: Data entry and submit for positing on "Variety Testing" website.
2. SC: Data entry and submit for positing on "Variety Testing" website.
3. SRKN:
  - a. Greenhouse: Data entry and submit for positing on "Variety Testing" website.
  - b. Field plots: Data entry and submit for positing on "Variety Testing" website.

<b>Project Title</b>	Integrated Management of Soybean Nematodes in Arkansas
<b>Lead Investigator</b>	Travis Faske
<b>Co-Investigator(s)</b>	Michael Emerson, Amanda Greer, and Joanna (Asia) Kud
<b>Status</b>	Year 3 of 3
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. Determine the efficacy and practicality of labeled nematicides for nematode management.</li> <li>2. Evaluate the field performance of available and new soybean cultivars against RKN.</li> <li>3. Determine how reniform nematodes impact yield in soybean.</li> <li>4. Promote the importance of sampling soybean fields for soybean nematodes.</li> <li>5. Assess and extend the use of cultural practices to manage soybean nematodes.</li> <li>6. Extend and educate clientele on the distribution of important soybean nematodes in the state.</li> </ol>

**Progress/Accomplishments:**

1. Two seed-applied and two soil-applied nematicide trials were planted on May 22 in a field with a history of southern root-knot nematode. Soybean roots were collected in July to assess the impact of nematicides to suppress RKN infection/galling. Analysis indicated no significant suppression of root system galled by either nematicide application type.
2. Thirty MG IV and 20 MG V cultivars with tolerance to glyphosate, dicamba, or 2,4-D were planted on May 22 in a field with a history of southern root-knot nematode. An susceptible control was added to each group. Six roots from each plot were assessed for galling as an indication of susceptibility in August. The screen was good this year, as some cultivars averaged >60% root system galled.
3. Greenhouse trials were conducted to evaluate the reproduction of southern root-knot nematode on MR-RKN soybean varieties. Further, a greenhouse trial was completed to evaluate the magnitude of root protection by ILEVO in various soil texture classes.
4. Corn samples are currently being collected to evaluate RKN reproduction as the corn plant advances across various growth stages.
5. Samples are being received by NDL that are sponsored by the ASPB. Some 250 samples to date have been received and we anticipate more based on questions about sample submission process.

**Upcoming Action/Activities:**

1. Waiting on harvest.
2. Entering data for analysis, awaiting harvest, and results will be posted to Arkansas Row Crops Blog and distributed to county ag agents.
3. Nematode survival in volunteer corn will happen at the end of the season.
4. Nematode soil samples will continue into the winter months.
5. Data and important results will be shared with farmers and consultants at winter production meetings.

<b>Project Title</b>	Monitor and Management of Fungicide-Resistant Soybean Diseases in Arkansas
<b>Lead Investigator</b>	Travis Faske
<b>Co-Investigator(s) Status</b>	Alejandro Rojas Year 2 of 3
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. Evaluate the efficacy and timing of fungicides, labeled and experimental, to control S-R FLS and other foliar diseases (Faske).</li> <li>2. Investigate the risk and existence of fungicide-resistance in <i>Cercospora</i> spp. and other foliar diseases to DMI and SDHI fungicides (Faske &amp; Rojas).</li> <li>3. Develop fungicide-resistance management strategies to delay or prevent fungicide-resistant diseases (Faske &amp; Rojas).</li> </ol>

**Progress/Accomplishments:**

1. A frogeye leaf spot susceptible cultivar, Progeny ‘P4806XFS’, was planted on June 3 at Jackson County Extension Center to evaluate labeled and experimental fungicides to control S-R FLS and assess response of fungicides to target spot (*Corynespora cassiicola*). To improve opportunities for fungicide studies a second location in Pulaski County was planted with Pioneer ‘P45A29L’ on May 22 and third location with Delta Grow ‘DG46E10’ on May 8 at Vegetable Research Station near Kibler. Fungicides were sprayed in July at Kerr and Kibler. Disease ratings were collected at R4/R5 growth stage in August.
2. The collection of *C. cassiicola* is being screened for fungicide resistance against QoI and SDHI chemistries. Based on molecular techniques, the presence of QoI resistant isolates continues to be high, but more importantly is the presence of SDHI resistant isolates in Arkansas. Thus, farmers will likely see reduced efficacy from SDHI fungicides in the future in fields treated from target spot.

**Upcoming Actions/Activities:**

1. Waiting on harvest and then final analysis.
2. We will continue screening the population for mutations associated with SDHI and QoI fungicides, summarizing the results from 2022 and 2023 and establishing resistance management strategies to delay or prevent the advance of mutation frequency in Arkansas soybean fields.

**Title:** Developing a satellite-based field scouting tool

**Lead Investigators:** Dr. Terry Spurlock, Extension Plant Pathologist, Department of Entomology and Plant Pathology, Division of Agriculture

**Co-Investigators:** Dr. Jeremy Ross, Extension Soybean Agronomist, Department of Crop, Soil, and Environmental Sciences, Division of Agriculture

**Status:** Year 1

**Research Areas:** Plant Pathology, Precision AG, IPM

**Stated Goal:** To develop a tool that uses publicly available satellite imagery to increase scouting efficiency by locating areas in fields that should be scouted

**Specific Objectives:**

1. Work with farmers, consultants, and county agents to locate test fields each year. A portion of these fields will be Arkansas Soybean Verification fields. We expect to scout approximately 20 fields per year.
2. Run the tool weekly from April 1 to October 1 on soybean fields and scout areas of fields the tool locates from V1 through maturity (R8).
3. Collect relevant data relating to soybean health and productivity (stand, weed populations, diseases present, insect counts, etc.) at each area the tool locates as well as soil samples and grain samples (for quality assessments) from areas the tool frequently locates.
4. Test different vegetation indexes and mathematical models to determine the best single model or combination of models for field scouting.
5. Year 3 – deploy the beta version of the tool to be used by county agents, consultants, scouts, and/or farmers.

**Progress/Accomplishments:** The tool has been running successfully since spring with several fields marked for scouting. Fields include soybean verification, fields marked for fungicide strip trials, and fields identified as having significant disease issues. Through preliminary runs, a combination of 12 different vegetation indices have been chosen to be used for field scouting in crop year 2023. When fields were scouted, these indices produced unique scouting points that locate the relatively ‘healthiest’ and problematic field areas. From field observations it was clear that the extreme measures of plant health were somewhat inadequate to capture all the disease issues that might be of interest to a field scout. For this reason, the code of the tool was changed to select points that were within categories of plant health both relatively lower and higher.

**Upcoming Actions/Activities:** We will continue to scout fields and determine the usefulness of the vegetation indices currently part of the model. We are also evaluating the delivery of files, file type, and apps that can be used to read the files generated by the scouting tool. As this field season ends, we will collect soil samples at specific positions identified by the tool to determine soil nutrient levels and nematode populations.

**Upcoming Actions/Activities:**

Numerous other field trials have been established on research stations and on farms that can be sampled for seed quality. Trials will be chosen based on treatment differences, either from fungicide, insecticide, or variety based on visible symptoms of disease.

**Title:** Determining the value of fungicide application using on-farm trials

**Lead Investigators:** Dr. Terry Spurlock, Extension Plant Pathologist, Department of Entomology and Plant Pathology, Division of Agriculture

**Co-Investigators:** Dr. Jason Davis, Application Technology Specialist, Division of Agriculture

**Status:** Year 1

**Research Areas:** Plant Pathology, Precision AG, IPM

**Stated Goal:** To cooperate with farmers, consultants, and county agents to determine when and where a fungicide application or fungicide + product(s) marketed to improve plant health protects a soybean crop and adds value above the input cost.

1. **Specific Objectives:** Work with farmers or consultants on their farms to determine the value of product applications if applied across the entirety of their soybean acreage. This project is targeted to early-career farmers that may struggle with these decisions.
2. **Test products that the farmer and consultants would like to see.** They guide the test. Products will be applied within label specifications. However, individual rates will be determined by the manufacturers and retailers' representatives. Products will be applied as they are sold.
3. **Utilize strip trials combined with spatial analysis** to allow integration of whole-field product efficacy with remote sensing technology (aerial imagery via UAVs and satellites, soil maps, and yield monitor data) to answer additional questions regarding within-field product efficacy, disease spread, and within-field difference in impacts of foliar diseases.
4. **Utilize drones** to apply products and determine efficacy against traditional ground applications both site-specifically and whole-plot.

**Progress/Accomplishments:** Fungicide trials have been established at locations in Jefferson, Arkansas (2), Craighead, Drew, Desha, Chicot, White and Lincoln Counties at growth stage R3. Planned trials at locations in Ashley and Lafayette Counties could not be completed due to successive rainfall events. Products applied at each location differed but included 3 replications of Miravis Top at 13.7 fl oz/A, and a nontreated control and either Revytek at 8 fl oz/A or Lucento at 5.5 fl oz/A with a ground sprayer applying 10 gallons of water/A. Fields were scouted and rated for foliar disease levels just prior to R6. Aerial imagery was collected at the time of fungicide application and again at disease rating. Trials at Drew, Arkansas, Jefferson, and Chicot Counties were harvested and sampled to determine differences in grain quality by treatment.

**Upcoming Actions/Activities:** An automated report detailing field specifics such as product impact to yield and foliar diseases, as well as soil type, field imagery, and a brief technical explanation of the trial and findings will be provided to each cooperating grower and county agent as well as reports to the Soybean Board and summarized on the Arkansas Row Crops Blog and in regional presentations.



**Title:** Determining factors associated with poor grain quality in soybean and management options

**Lead Investigators:** Terry Spurlock, Nick Bateman, John Rupe, Alejandro Rojas

**Status:** Year 2 of 3

**Objectives:**

Determine the major factors affecting soybean seed quality and develop management strategies for growers to avoid quality losses

**Specific Objectives:**

1. Determine differences in grain quality caused by fungal diseases and disorders among varieties in the official variety trial at Rohwer Station annually (Spurlock).
2. Establish an early and a late planted fungicide trial at Rohwer Station each year based on data collected from the previous season's official variety trial. Varieties with significantly higher diseases impacting grain quality will be chosen for these trials. The aim will be to determine the impact of various fungicide timings on varieties that have shown susceptibility to diseases and disorders negatively impacting grain quality (Spurlock).
3. Samples will be taken from on-farm fungicide trials (4 – 5 trials annually) at harvest and sent to Riceland Foods in Stuttgart for grading and the Spurlock Lab to determine levels of diseases and disorders that impact grain quality (Spurlock).
4. Grain will be sampled from multiple stink bug trials throughout the state with significantly different levels of stinkbug or other insect feeding and grain quality determined. Additionally, samples will be sent to Fayetteville for fungal pathogen identification that may be related to damage caused by insect feeding (Bateman).
5. Seed samples will be assessed visually for quality and fungal infection will be evaluated to determine major pathogens affecting soybean seed quality (Rupe and Rojas).

**Progress/Accomplishments:** Two separate trials were established at Rohwer Research Station on 7 Jun at 110,000 seed/A in a randomized complete block with 6 replications. One trial planted to NK43Y9XFS and another to AG56XF2. Plots were 6-rows wide and 40-ft long on 38-in. row-spacings. Treatments included 5 fungicide treatments applied at R3 on 21 Aug or R5 on 11 Sep including an untreated control. Treatments were applied using a backpack sprayer in 10 GPA water volume at approximately 40 psi. Plots were also rated for foliar disease at application. Foliar diseases assessed were Cercospora leaf blight (CLB), Frogeye leaf spot (FLS) and Target leaf spot (TLS) were observed as shown in the table below. Ratings shown are averages across all treatments based on a 0-9 scale where 0 = no disease and 9 = plant death.

Prior to harvest green stem ratings will be taken and yield at harvest. Grain samples from each plot will be collected from the plot combine at harvest. Grain will be observed for *Phomopsis* seed decay, purple seed stain, and insect damage by counting the grains exhibiting damage from these pests, dividing that number by the total number of grains observed and expressed as a percentage. Overall seed quality (SDQ) will likewise be calculated as the percentage of grain per sample without noticeable defects. All data will be subjected to statistical analysis.

**Upcoming Actions/Activities:**

Numerous other field trials have been established on research stations and on farms that can be sampled for seed quality. Trials will be chosen based on treatment differences, either from fungicide, insecticide, or variety based on visible symptoms of disease.

CONFIDENTIAL

**Title:** Understanding Taproot decline and orange leaf spot; soybean diseases of increasing importance in Arkansas

**Lead Investigators:** Terry Spurlock and Alejandro Rojas, UA System Division of Agriculture

**Co-Investigators:**

**Status:** Year 1

**Stated Goal:** To determine management strategies for taproot decline and determine the causal agent for orange leaf spot, a disease generating questions by consultants and industry representatives

**Specific Objectives:**

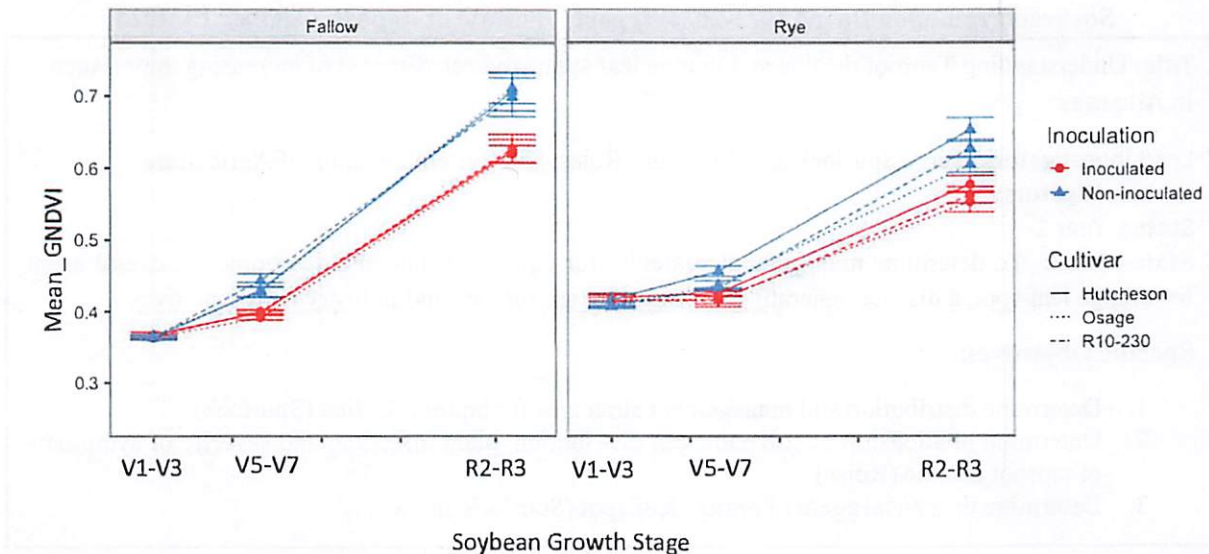
1. Determine distribution and management strategies for taproot decline (Spurlock)
2. Determine relationship of soil pathogen distribution, plant infection, and severity of symptoms of taproot decline (Rojas)
3. Determine the causal agent of orange leaf spot (Spurlock and Rojas)

**Progress/Accomplishments:**

Six separate soybean trials were established based on maturity group at Rohwer Research Station on 9 Jun at 110,000 seed/A in a randomized complete block with 8 replications. Plots were 4-rows wide and 20-ft long on 38-in. row-spacings. All rows were inoculated with the fungus causing taproot decline (TRD) by infesting sterile millet with a local isolate and planting the millet with the seed at 0.5g/row-ft. The two left rows were treated with thiophanate-methyl at 20 fl oz/A in-furrow at plant in 10 gal/A water volume. Eighty-one Xtend varieties were planted by maturity group and plant stands were collected 21 and 27 Jun and 11 Jul by counting all plants in one inoculated and one uninoculated row, separately. Average plant stands by treatment within a maturity group are shown in the table below.

The 2023 TRD cover crop trial at Milo Shult Research Farm has a split-plot design (cover crop and fallow) with a complete randomized block design using three cultivars: Hutcheson, Osage, and R10-230 and with or without inoculation of *X. necrophora* (TRD). After planting, data was collected from each experimental plot at four different growth stages: I) vegetative stage V1-V3 in early June; II) vegetative stage V5-V7 in late June; III) reproductive stage R2-R3 in early August; and IV) reproductive stage R5-R7 in early September. The data include disease visual assessment, photosynthesis-related parameters (SPAD), aerial imagery, and root samples. The disease visual assessment was collected using both disease severity (highest scale of disease in the plot rated, scale from 0-5, with 0 meaning healthy and 5 meaning dead plant caused by infection) and incidence (% of plants showing symptoms). All inoculated plots showed disease severity in all scales at different growth stages, with the highest disease incidence at 40% between vegetative stages V5 – V7. We analyzed the Green Normalized Difference Vegetation Index (GNDVI) and observed higher values in the non-inoculated plot in all cultivars since V5-V7. At growth stage R2-R3, fallow-treated plots tend to have higher GNDVI than cover crop treated plots regardless of the inoculation.

For each growth stage, roots were collected to be processed for the detection of the pathogen. We have finished grinding half of the root samples collected (96 bags from non-inoculated plots) using a laboratory mill.



**Figure 1.** The Green Normalized Difference Vegetation Index (GNDVI) of the soybean at different growth stages. GNDVI is a vegetation index for estimating photosynthetic activity, water, and nitrogen uptake into the canopy. The higher value indicates a more active photosynthetic activity.

**Upcoming Actions/Activities:**

Taproot decline will continue to be monitored at the county level throughout the season and the updates state-wide distribution will be made available at season's end. Trials at Rohwer will be harvested with a plot combine to determine the impact to yield of TRD on the varieties tested and the efficacy of foliar fungicide on TRD susceptible varieties.

The trial at Milo Shult research station will be monitored for plant symptoms and plant samples and aerial images will be collected at two more growth stages. Molecular diagnostics are under development, and we will start testing field samples this year to determine colonization and associate colonization with symptoms.

**Title:** The effects of the inclusion of soybean oil in beef heifer diets on reproductive performance

**Lead Investigators:** Elizabeth Kegley, Jeremy Powell, Charles Looney, Brittni Littlejohn, and Kirsten Midkiff

**Co-Investigators:**

**Status:** New

**Objectives:** The objectives of this project are to determine the effect of feeding soybean oil in developing beef heifer diets on: 1) growth performance and average daily gain; 2) reproductive tract scores; 3) time of cyclicity and puberty; 4) successful AI rates; 5) overall pregnancy rates; and 6) economic viability.

**Progress/Accomplishments:**

The developing heifer study began on June 14, 2023. There were 80 heifers (the proposal indicated n = 72 heifers, but more were available to use when the trial began) that were assigned to 1 of 2 supplemental treatments, being 1) control group fed an isonitrogenous and isocaloric grain supplement with no soy product (CON); and 2) treated group fed grain supplemented with soybean oil at 2% of total diet dry matter intake (SO2). Heifers were weighed on July 13, 2023.

Starting on August 10, 2023, heifers had body weights taken every 28 days. Beginning when heifers weigh > 650 pounds, an ultrasound was used to determine ovary size, dominant follicle size, and follicular structures on the ovary, and rectal palpation was conducted to determine the tone and diameter of the uterine horns (reproductive tract scoring; RTS). Heifers will only have one ultrasound and RTS performed prior to the breeding season. As of d 111, 77 heifers have reached the threshold weight and have had an ultrasound performed. Also, a blood sample has been collected weekly from heifers via jugular venipuncture to analyze serum progesterone concentrations, which will allow for us to determine when heifers are cyclic and pubertal. The heifers will be declared as pubertal when the serum progesterone concentrations are greater than 1 ng/mL for two consecutive samples; the heifers that have met this criterion will not be bled further. There are 47 heifers that have been declared pubertal as of d 111.

**Upcoming Actions/Activities:**

Prior to the breeding season on day 140 of the study (November 2023), heifers will be weighed a final time and any heifers that have not reached 650 pounds will be removed from the study. A second ultrasound for ovarian structures, RTS, and pelvic measurements will be recorded for all heifers remaining on the study. A blood sample will be collected from heifers via jugular venipuncture for plasma fatty acid analysis. Feed samples will also be collected for total fatty acid analysis and chemical composition. At approximately 13 months of age (November 2023), heifers will be estrus synchronized and then bred via artificial insemination (AI) to a single AI sire. Heifers will then be exposed to a bull 10 days following AI (December 2023) and will remain with the bull for 56 days. An ultrasound will be performed and body weights taken 45 days (January 2024) and 90 days (March 2024) after AI. The ultrasound will allow for confirmation of a pregnancy and to determine whether AI was successful. The confirmation of AI pregnancies and overall pregnancy will be recorded for analysis.

Costs that are associated with the developing the heifers (i.e., vaccination, deworming, costs of breeding, labor, and feed) will be recorded. Additionally, the respective values for pregnant versus nonpregnant heifers will be assessed.

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**Title:** Assessment of broiler dietary least cost protein supply via soybean genotype amino acid selection improvements

**Authors:** M. T. Kidd<sup>1</sup>, S. C. Wells-Crafton<sup>1</sup>, and A. Acuna-Galindo<sup>2</sup>

<sup>1</sup> Professor and Graduate Assistant, respectively, Department of Poultry Science, Fayetteville.

<sup>2</sup> Program Associate, Molecular Laboratory Operations, Department of Crop, Soil, and Environmental Sciences, Fayetteville.

**Abstract:** This experiment aims to determine the feeding value of soybean meal (SBM) produced from a variety of soybeans bred for increased amino acid content, compared to soybean meals from conventional soybeans. The nutritionally enhanced variety of soybeans (IP-AA) was processed by Insta-Pro International alongside conventional soybeans sourced by Insta-pro (IP-Conv.) using high shear dry extrusion. Additionally, conventional solvent extracted soybean meal (UA-Conv.) was acquired from the University of Arkansas Poultry Feed Mill. Prior to diet formulation, all soy ingredients were submitted for total amino acid and proximate analysis. Three corn and soy-based diets were formulated based on energy value and amino acid profile with each diet containing a different soybean meal source. Diet 1 contained UA-Conv. SBM, Diet 2 contained IP-Conv. SBM, and Diet 3 contained IP-AA SBM. Diets were fed to 540 Cobb 500 male broilers placed in 10 replicate pens of 18 birds and live performance was assessed during the starter (0-14d), grower (14-28d), and finisher (28-45d) phases. At d 45, eight birds from each pen were randomly selected and processed for evaluation of carcass traits and

incidence of woody breast. Carcass parameters measured include live weight as well as fat, breast, tender, wing, and leg chilled yields. Additionally, 2 birds per pen will be assessed for gut health using FITC-D oral gavage methods, and intestinal samples will be collected following cervical dislocation to determine differences in gut morphology. All performance data were analyzed using a One-way ANOVA using JMP software with diet as the fixed effect and block as a random effect with pen as the experimental unit. Statistical significance was considered at  $P \leq 0.05$ . No results are available at this time as this trial is currently underway.

**Introduction:** Soybean meal is the number one protein contributing ingredient used in North American poultry diets. The popularity of soybean meal in U.S. poultry diets is largely due to soybean's duality as a protein ingredient and an oil producer, its high quality as a protein ingredient, and its ability to be grown in the United States. In the past, soybean breeding objectives were mostly focused on improving yields, pest resistance, lodging resistance, and shattering resistance (Shurtleff and Aoyagi, 2020). Today common breeding objectives include improving yields, herbicide resistance, disease and pest resistance, and drought tolerance. However, with recent increases in identity preservation practices of agricultural commodities we are seeing a growing interest in genetically selecting for soybeans with improved nutrition. Since 1986, overall yield of U.S. soybeans has increased from 2241 kg/ha to 3412 kg/ha; however, nutritional quality has remained relatively the same (Naeve and Miller-Garvin, 2020). In recent years, a few varieties of soybeans have been developed that have been bred to have improved nutritional value by improving protein and amino acids (Edwards et al., 2000; Baker et al., 2011), improving fatty acid profile (McNaughton et al., 2008; Mejia et al., 2010), reducing oligosaccharides (Parsons et al., 2000, Chen et al., 2013; Perryman et al., 2013), and reducing

trypsin inhibitors (Bajjalieh et al., 1980; Han et al., 1991; Zhang et al., 1991; Douglas et al., 1999). At the University of Arkansas, a line of soybeans is being developed that has been specifically bred to have increased amino acid content. Feeding this ingredient in broiler growth trials will be necessary to assess the value of soybean genetic selection for increased amino acid content to the soybean and poultry industry. Poultry nutritional studies that assess the value of novel and alternative ingredients are necessary as the global population continues to increase to 9.7 billion by 2050 (U.N., 2019). This will inevitably cause strain on resources making it difficult for nutritionists to meet the nutrient requirements of poultry. Therefore, the studies that are currently underway aim to develop, identify, harvest, crush, and feed soybeans with improved traits to broilers, and assess broiler live performance, intestinal permeability, carcass yields, and economics. We hypothesize that the improved line of soybeans and subsequent meal will allow for broiler companies to meet the amino acid requirements of poultry with less soybean meal inclusion which could provide a viable and economical option for filling the “protein-gap”.

**Procedures:** Three corn and soy-based diets were formulated based on energy value and amino acid profile with each diet containing a different soybean meal source. Diet 1 contained UA-Conv. SBM, Diet 2 contained IP-Conv. SBM, and Diet 3 contained IP-AA SBM. The nutritionally enhanced variety of soybeans (IP-AA) was processed by Insta-Pro International alongside conventional soybeans sourced by Insta-pro (IP-Conv.) using high shear dry extrusion. Additionally, conventional solvent extracted soybean meal (UA-Conv.) was acquired from the University of Arkansas Poultry Feed Mill. Each treatment will be represented by 10 replicate pens. There will be a three-phase feeding program; experimental starter (0-14d), experimental



grower (15-28d) and an experimental finisher phase (29-45d). Eighteen day of hatch chicks will be allocated pens that measure 6 x 8 feet with feed and water being offered ad libitum. Birds will be weighed at the beginning and conclusion of the experimental period (1, 14, 28, and 45d). Feed consumption will be recorded for the length of the experimental period. On d45, eight birds per pen will be randomly selected for processing for determination of carcass traits. Additionally, 2 birds per pen will be assessed for gut health using FITC-D oral gavage methods, and intestinal samples will be collected following cervical dislocation to determine differences in gut morphology. Measurements include: feed disappearance, body weight gains, feed conversion, mortality, complete parts chilled yields, meat quality, foot pad scores, and breast myopathies.

**Results and Discussion:** No bird performance results are available at this time as the forementioned trial is currently underway. Table 1. Shows Nutrient composition of experimental soybean meals. IP-Conv. and IP-AA contained higher ether extract (fat) content than UA-Conv. Moreover, IP-AA contained similar crude protein content compared to UA-Conv. despite having a much higher fat content. The combination of these factors resulted in large decreases in estimated diet cost for diets formulated using IP-AA. During the starter phase estimated diet cost for diets containing UA-Conv. was \$338.17 compared to \$323.80 for diets containing IP-Conv. and \$309.99 for diets containing IP-AA. The driving force for this cost savings is the increase in fat content for the IP meals and the high crude protein content for the IP-AA meal. We can see this trend continued in the grower and finisher phases. We hypothesize that due to the similarities in overall diet composition, bird performance will be similar for all treatments. The IP-AA soybean meal will result in reduced diet cost due to lower diet soybean meal and fat inclusion, but bird performance should be maintained.

Nutrients	UA-Conv. SBM	IP-Conv. SBM	IP-AA SBM
Nitrogen-Free Extract	30.34	35.24	32.39
Ether Extract	2.31	6.93	7.57
Crude Protein	45.76	42.88	45.19
Moisture	11.68	5.66	5.75
Fiber	3.5	3.6	3.4
Ash	6.41	5.69	5.7
Metabolizable Energy	2260	2419.5	2506

Ingredient, %	Diet 1	Diet 2	Diet 3
Corn	55.07	56.54	59.01
Soybean Meal	38.55	38.36	36.78
Oil, Poultry Fat	2.89	1.57	0.61
Dicalcium Phosphate	1.28	1.28	1.29
Limestone	0.76	0.77	0.77
Salt	0.38	0.38	0.38
DL-Methionine 99%	0.33	0.37	0.34
L-Lysine HCl, 78.8%	0.22	0.20	0.26
L-Valine 98%	0.16	0.17	0.18
L-Threonine, 98%	0.12	0.13	0.15
Trace Mineral Premix	0.10	0.10	0.10
Vitamin Premix	0.08	0.08	0.08
Coccidiostat	0.05	0.05	0.05
Calculated analysis, % unless otherwise noted			
ME, kcal/kg	3000	3000	3000
CP, %	23.47	22.44	22.91
Digestible TSAA, %	0.96	0.96	0.96
Digestible Lys, %	1.28	1.28	1.28
Digestible Thr, %	0.87	0.87	0.87
Digestible Arg, %	1.33	1.33	1.33
Digestible Trp, %	0.23	0.22	0.21
Digestible Val, %	0.99	0.99	0.99
Digestible Leu, %	1.70	1.70	1.68

Dig Ile, %	0.89	0.88	0.86
Ca, %	0.75	0.75	0.75
P, avail., %	0.38	0.38	0.38
Na, %	0.17	0.17	0.17
Estimated diet cost \$USD/ton	\$338.17	\$323.80	\$309.99

Table 3. Composition of experimental grower diets fed from 14-28d of age			
Ingredient, %	Diet 1	Diet 2	Diet 3
Corn	60.24	61.50	63.63
Soybean Meal	33.23	33.07	31.70
Oil, Poultry Fat	3.21	2.07	1.24
Dicalcium Phosphate	1.23	1.22	1.23
Limestone	0.77	0.78	0.78
Salt	0.39	0.39	0.39
DL-Methionine 99%	0.27	0.31	0.28
L-Lysine HCl, 78.8%	0.21	0.20	0.25
L-Valine 98%	0.13	0.14	0.15
L-Threonine, 98%	0.10	0.11	0.12
Trace Mineral Premix	0.10	0.10	0.10
Vitamin Premix	0.08	0.08	0.08
Coccidiostat	0.05	0.05	0.05
Calculated analysis, % unless otherwise noted			
ME, kcal/kg	3075	3075	3075
CP, %	21.44	20.55	20.96
Digestible TSAA, %	0.86	0.86	0.86
Digestible Lys, %	1.15	1.15	1.15
Digestible Thr, %	0.78	0.78	0.78
Digestible Arg, %	1.20	1.20	1.20
Digestible Trp, %	0.21	0.20	0.19
Digestible Val, %	0.89	0.89	0.89
Digestible Leu, %	1.59	1.59	1.57
Dig Ile, %	0.80	0.79	0.78
Ca, %	0.72	0.72	0.72
P, avail., %	0.36	0.36	0.36
Na, %	0.17	0.17	0.17

Estimated diet cost \$USD/ton	\$326.21	\$313.83	\$301.93

Table 4. Composition of experimental finisher diets fed from 28-45d of age			
Ingredient, %	Diet 1	Diet 2	Diet 3
Corn	63.75	64.86	63.63
Soybean Meal	29.20	29.06	31.70
Oil, Poultry Fat	3.84	2.84	1.24
Dicalcium Phosphate	1.21	1.21	1.23
Limestone	0.77	0.77	0.78
Salt	0.39	0.39	0.39
DL-Methionine 99%	0.23	0.26	0.28
L-Lysine HCl, 78.8%	0.20	0.19	0.25
L-Valine 98%	0.11	0.12	0.15
Trace Mineral Premix	0.10	0.10	0.12
L-Threonine, 98%	0.08	0.09	0.10
Vitamin Premix	0.08	0.08	0.08
Cocciostat	0.05	0.05	0.05
Calculated analysis, % unless otherwise noted			
ME, kcal/kg	3150	3150	3150
CP, %	19.86	19.08	19.44
Digestible TSAA,%	0.79	0.79	0.79
Digestible Lys, %	1.05	1.05	1.05
Digestible Thr, %	0.71	0.71	0.71
Digestible Arg, %	1.09	1.09	1.09
Digestible Trp, %	0.19	0.18	0.17
Digestible Val, %	0.81	0.81	0.81
Digestible Leu, %	1.50	1.50	1.48
Dig Ile, %	0.73	0.72	0.71
Ca, %	0.70	0.70	0.70
P, avail., %	0.35	0.35	0.35
Na, %	0.17	0.17	0.17
Estimated diet cost \$USD/ton	\$321.64	\$310.75	\$300.30

**Practical Applications:** The improved line of soybeans and subsequent meal will allow for broiler companies to feed birds less protein which reduces farm greenhouse gas emissions, reduces bird water intake, and improves bird welfare. The soybean industry can consider scalable production of the former seeds based on yields and identity preserved economics.

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## Arkansas Soybean Promotion Board – Fall 2023 Report

**Title:** An innovative approach to generate porous soy proteins with enhanced flavor for the plant-based food industry

**Lead Investigator:** Ali Ubeyitogullari

**Status:** New (Year 1 of 3)

**Research Areas:** Post-Harvest

**Stated Goal:** *The goal of this project* is to generate functionalized soy protein particles with improved flavor profile using a novel supercritical carbon dioxide (SC-CO<sub>2</sub>) technology and 3D food printing. SC-CO<sub>2</sub> loading of flavoring compounds (*i.e.*, dairy flavors) into soy proteins provides a unique opportunity to increase their utilization in alternative dairy products while eliminating the use of any toxic organic solvent. In addition, the heat treatment involved during soy protein particle formation effectively reduces the activity of trypsin inhibitors as well as decreases soybean allergenicity. Overall, this project will add value to soybeans, create new avenues for soy proteins in the food industry with higher prices, and, in turn, increase the profitability of soybean growers.

### **Specific Objectives:**

1. Extract off-flavors (*i.e.*, polyunsaturated fatty acids, aldehydes, ketones, and alcohols) from defatted soybean flour using a sequential pure SC-CO<sub>2</sub> and ethanol-modified SC-CO<sub>2</sub>.
2. Extract soy protein isolate from off-flavor-removed, defatted soybean flour using an alkaline extraction method, and generate soy protein micro-and nanoparticles using an SC-CO<sub>2</sub>-assisted particle formation system.
3. Load model dairy flavoring compounds into the microstructure of the produced protein particles using SC-CO<sub>2</sub>, and generate alternative cream cheese using the functionalized soy protein isolates and 3D food printing.

### **Progress/Accomplishments:**

Progress has been made on the first objective of the proposed project, where we focused on the development of a sequential pure SC-CO<sub>2</sub> and ethanol-modified SC-CO<sub>2</sub> extraction method. The new hire, PhD student, Sumanjot Kaur, has started working on the project. Soybeans were ground and used for extraction experiments. The extraction of aromas from the defatted soybean flour is currently ongoing. Currently, we are optimizing the SC-CO<sub>2</sub> conditions (*i.e.*, pressure, temperature, time, and cosolvent ratio) in removing the off aromas. The flour samples subjected to SC-CO<sub>2</sub> extraction were analyzed via a GC-MS to determine their volatile compounds composition.

### **Upcoming Actions/Activities:**

Over the next reporting period, we plan to continue working on the first objective to optimize the SC-CO<sub>2</sub> process. We will characterize the off aromas in SC-CO<sub>2</sub>-treated samples and compare them with the control (*i.e.*, untreated soybean flour). A commercially available soybean flour will also be analyzed for comparison purposes. An abstract will be submitted to an international scientific conference (*i.e.*, the American Oil Chemists' Society (AOCS) Annual Meeting and Expo).

**Title: Soybean Research Verification Program**

**Lead Investigators: Jeremy Ross**

**Co-Investigators: Chad Norton and Chris Elkins**

**Status: Year 1 of 3 - Continuing**

**Objectives:**

- To conduct field trials to verify that high yields can be profitably produced by coordinating the implementation of all research-based recommendations.
- To aid researchers in identifying areas of soybean production and marketing that need further study.
- To improve recommendations which contribute to profitable soybean production utilizing both irrigated and non-irrigated production of both early season (indeterminate) and conventional (determinate) varieties into economically sustainable soybean production systems for the Arkansas farmers.
- To utilize the Soybean Research Verification Program (SRVP) concept to maintain and improve producers, County Extension Agents' and other crop advisors' soybean production and marketing expertise.

**Progress/Accomplishments:**

For the 2023 growing season, there are fifteen fields enrolled in the Soybean Research Verification Program (SRVP). Seven fields are considered early-season irrigated, seven fields considered full-season irrigated, and one field considered late-season irrigated. Planting dates ranged from March 22 to June 21, 2023, with fields ranging in size from 30 to 100 acres. Three herbicides technologies were represented in the SRVP including Xtend, XtendFlex, and Enlist. Fields are scouted on a weekly schedule, and recommended application and production practices will be applied when needed.

**Upcoming Actions/Activities:**

Fields will continue to be scouted on a weekly schedule until maturity and needed management practices will be applied. Yield and economic data will be analyzed, and presented at County, state, and regional meetings and publications will be developed to report the 2023 SRVP findings.



Arkansas  
**ROW CROP VERIFICATION**



2023 Soybean Research Verification Program  
Fields  
Coordinators: Chris Elkins & Chad Norton



County	Agent	Cooperator	Variety	Production System	Year	Planting Date	Row Spacing	Acres
Arkansas	Phil Horton	Wil-Dar Farms	Pioneer P45A40LX	Early Season Irrigated	1	3/29	38" twin	80
Chicot	Kurt Beaty	Salt and Pepper Farms	Asgrow AG46X6	Early Season Irrigated	1	4/16	38" twin	60
Cross	Jenna Martin	Stephens Farms	Virtue 4520S	Full Season Irrigated	1	5/8	30"	70
Drew	Scott Hayes	Michael Oltmann	Asgrow AG46X0	Early Season Irrigated	1	4/19	30"	35
Greene	Dave Freeze, Lance Blythe	Distretti Farms	Innvictis B4841E	Full Season Irrigated	2	5/8	30"	65
Jackson	Matthew Davis	Mike Jones	Pioneer P48A14E	Full Season Irrigated	1	5/17	30"	40
Jefferson	Brady Harmon	Brett Stewart	Pioneer P46A36X	Early Season Irrigated	1	3/22	38" twin	50
Lawrence	Bryce Baldrige, Courtney Sisk	Hicks Family Ag.	Stine 46EE20	Early Season Irrigated	1	4/11	30"	70
Lonoke	Keith Perkins, Andrew Bolton	Jordan Lynch	Asgrow AG46F3	Full Season Irrigated	2	5/4	30"	100
Mississippi	Alan Beach, Ethan Brown	DMS Farms	Becks 4991X2	Early Season Irrigated	1	4/11	38" twin	70
Poinsett	Jeffery Works, Craig Allen	Cale Reddmann	Asgrow AG46FX3	Late Season Irrigated	1	6/21	7.5"	35
Randolph	Mike Andrews	Scott Brown	Pioneer P52A14SE	Full Season Irrigated	1	5/8	7.5"	40
St. Francis	Sarah Stone	Lizza Clarie Farms	Pioneer 46A20LX	Early Season Irrigated	1	4/1	38" twin	30
White	Jerrold Haynes	Hambrick Farms	Armor 46-E50	Full Season Irrigated	1	5/15	30"	40
Yell	Brandon Yarbery, Bob Powell	Ault Farm	Pioneer P48A14E	Full Season Irrigated	1	5/10	30"	32

<b>Project Title</b>	Soybean Weed Management: A Team Approach for Improved Control and Profitability
<b>Lead Investigator</b>	Tommy Butts
<b>Co-Investigator(s)</b>	Tom Barber, Jason Norsworthy, Nilda Burgos
<b>Status</b>	Year 1 of 3
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1) To continue testing suspected resistant weed biotypes sent from county agents and soybean producers for herbicide resistance, particularly for glufosinate and auxin herbicide resistance, documenting the level of resistance and distribution, and determining the effectiveness of alternate herbicide modes-of-action on resistant biotypes</li> <li>2) To quantify the potential of multiple herbicide-resistant Palmer amaranth and other confirmed resistant weeds to spread in Arkansas by determining control programs, ecological fitness, and geographic distribution of resistant biotypes, and resistance and dispersal mechanisms likely to cause population expansion</li> <li>3) To identify and evaluate effective management programs (both short-term and long-term) for multiple herbicide-resistant Palmer amaranth including glufosinate and auxin herbicide resistance</li> <li>4) To evaluate the effectiveness of various agronomic practices (double crop, cover crop, etc.) for suppressing problematic weeds of Arkansas soybean production systems</li> <li>5) To determine how herbicide performance and selectivity are affected by environmental conditions (such as planting date, soil texture, climatic conditions), application procedure, application technologies (nozzles &amp; adjuvants), herbicide tank-mixture, weed species, and growth stage to develop more efficient and reliable herbicide weed management strategies</li> <li>6) To evaluate long term programs (chemical and cultural) to reduce the soil weed seedbank. These programs will include trials designed to study methods of destroying weed seed post-harvest and evaluate new harvest weed seed destruction equipment</li> <li>7) To evaluate the viability of new technologies (herbicides, traits, application tech, etc.) as they emerge for efficacy and the ability to safely apply in the agricultural and external environment</li> <li>8) To investigate spray technologies and application methods such as nozzle types, spray volumes, adjuvants, and specialized spray equipment (pulse-width modulation, See &amp; Spray, MagrowTec, etc.) to improve coverage and control from both ground and aerial applications</li> <li>9) To evaluate Arkansas spray water quality (pH and hardness), its impact on herbicide efficacy, and the role adjuvants may play in improving these aspects</li> <li>10) To evaluate fall-applied residual herbicides effectiveness on problematic Arkansas weeds (i.e. Italian ryegrass) and the resulting impact on spring burndown applications</li> <li>11) To evaluate herbicide program costs and resulting soybean yields to determine profitability potential of weed management options</li> <li>12) To provide rapid transfer of weed control information to growers through multiple outreach methods such as publications, blog posts, Weeds AR Wild podcasts, videos, text messages, and many others</li> </ol>

**Progress/Accomplishments:**

The team has approximately 100 soybean field trials that have been planted at multiple locations, including: Fayetteville, Keiser, Lonoke, Marianna, Newport, Rohwer, and Tillar, AR. We evaluated best management practices and program approaches across soybean systems, including Xtend, XtendFlex, Enlist, LibertyLink, and conventional soybean. We have continued to investigate metabolic resistance in Palmer amaranth to the PPO-inhibitors, VLCFA-inhibitors, and other herbicide chemistries, and the impact this resistance mechanism has for soybean growers. We determined that in general, soil-applied PPO-inhibitors are still effective on the majority of resistant Palmer amaranth populations; however, about 20% are no longer controlled effectively by soil-applied Reflex. The escaping plants all harbor target site mutations. Additionally, we have evaluated application technologies (specifically nozzles, adjuvants, carrier volumes, and spray water quality) to increase spray coverage and the overall effectiveness of herbicide applications. Research evaluating alternative cropping practices like crop rotation, cover crops, and varying row widths was conducted to assist with the suppression of problematic weed species through the implementation of integrated weed management (IWM) strategies. Studies utilizing sUAS imagery and See & Spray (Blue River Technology) were established to determine their viability for remote sensing and remote applications, as well as evaluate cutting-edge technologies. Additional studies evaluating weed control from both a weed seedbank management and profitability standpoint were conducted. At present, harvest of many of these trials is beginning. Further, multiple evaluations of the Redekop seed destructor at Newport and Keiser are just beginning to evaluate viability of this technology for Arkansas producers. Weed seeds are currently being collected from suspected resistant populations in fields where herbicide failure occurred. They will be evaluated relative to known susceptible standards for resistance under controlled conditions during this winter, and if failure still occurs, dose response experiments will be conducted to confirm resistance, determine the level of resistance, and map the distribution. Additional studies will be implemented soon (mid-Oct. to mid-Nov.) to evaluate fall burndown and residual options for the effective control of Italian ryegrass. Multiple avenues have been and will continue to be used to quickly disseminate generated information including blog posts, publications, face-to-face interactions, the SlickText mass texting service, and Weeds AR Wild podcast series.

**Value to Soybean Industry:**

Proper weed control accounts for a significant portion of annual budgeted production expenses. The rapid adoption and widespread use of soybean weed control information has been of great value to Arkansas growers. This project allows growers to closely follow the discovery of herbicide-resistant and new problematic weed species through timely information and assist with the management of these weeds on their farms. The discoveries of multiple glyphosate-resistant weed species and other herbicide resistance such as PPO-inhibitor, VLCFA-inhibitor-, glufosinate-, and auxin-resistant pigweed in Arkansas soybean fields has been a direct result of Soybean Board Funding. Failure to adequately control these weeds can result in total crop loss resulting in millions of dollars lost for Arkansas soybean producers. The identification of IWM opportunities to enhance program approaches and determine best use practices of new precision technologies can also aid in weed control and grower profitability. If the introduction of diverse strategies and scientifically-supported recommendations generated from this research can save even \$10/acre of input costs, that would provide an annual savings of \$35 million total for Arkansas soybean growers.

**Title:** Screening for Soybean Tolerance to Metribuzin

**Lead Investigators:** Jason K. Norsworthy

**Co-Investigators:** Jeremy Ross

**Status:** Year 3 of 3

**Objectives:** To assess the tolerance to metribuzin of soybean varieties entered in the Arkansas OVT and to provide rapid transfer of information regarding the level of tolerance or sensitivity of Arkansas grown soybean varieties to metribuzin

**Progress/Accomplishments:**

**Soybean varieties entered in the Arkansas OVT were screened for tolerance to metribuzin in September in greenhouse. Results were shared with Dr. Jeremy Ross and the information has been prepared for uploading to the Internet. The document to be uploaded was approved last week and should be available for growers to access in the coming weeks.**

<b>Project Title</b>	Optimization of fungal pathogens AF22 and AF24 as bioherbicides for Palmer amaranth (pigweed)
<b>Lead Investigator</b>	Burt Bluhm, UA-Fayetteville
<b>Co-Investigator(s)</b>	Kelly Cartwright, ARI Inc.
<b>Status</b>	Year 1 of 3 (Fall Report)
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. <i>Develop isolates AF22 and AF24 as biological control agents/bioherbicides of pigweed.</i></li> <li>2. <i>Identify host-specific toxins produced by isolates AF22 and AF24 for bioherbicide development.</i></li> <li>3. <i>Actively pursue commercialization of bioherbicide products derived from AF22 and AF24.</i></li> </ol>

#### **Progress/Accomplishments:**

Efforts through the summer and fall of 2023 focused on all three objectives. For the first objective, we have focused on two approaches so far this year. In the first approach, we have been evaluating traits of isolates AF22 and AF24 required for scale-up production/commercialization, primarily performance in liquid and/or solid state fermentation (to produce sufficient inoculum for commercial distribution) and thermotolerance (to evaluate production parameters and potential shelf life in cold storage). Any potential deficiencies will be addressed and optimized through genetic approaches. In parallel, we have also been evaluating and optimizing virulence of AF22 and AF24 on pigweed. We established a technique to mutagenize AF22 and AF24 and screen large numbers (>1,000,000 individual mutants) weekly in greenhouse assays. These mutants are non-transgenic and thus non-GMO. The goal is to find mutants with increased virulence that could either be used as a biocontrol product, or could provide crucial genetic information to enhance virulence of AF22 and AF24 through genome editing. Greenhouse screening of mutants is actively underway this fall.

For the second objective, we have recently utilized computational biology to predict putative genes in AF22 and AF24 involved in toxin production. We have predicted the putative toxin biosynthetic gene clusters in both organisms and performed comparative analyses to identify putative toxins, or categories of toxins, each cluster produces. Some of the predicted toxin biosynthetic clusters possessed by AF22 and AF24 are novel and of unknown function, and thus are encouraging candidates for further evaluation. This fall and winter, we are preparing a series of functional genomics studies (directed gene knockouts) combined with gene expression profiling to further pinpoint toxin biosynthetic genes. This work will complement chemical profiling of the toxin.

For the third objective, we are continuing discussions with experts in intellectual property protection and commercialization to move forward with product development. Refining whether AF22 and AF24 have the most potential as biocontrol organisms or as the source of a pigweed-specific toxin (or both) is a key point of current discussion.

Support from this project has also allowed us to continue work with other promising biocontrol strains targeting pigweed (*Colletotrichum* isolates, identified in the previous project).

**Title:** Use of gossypol to inhibit reproduction in domestic hogs as a model for feral hog control

**Lead Investigators:** B. P. Littlejohn

**Co-Investigators:** C. V. Maxwell, T. C. Tsai

**Status:** New Proposal (Year 1 of 3)

**Objectives:** 1. Using domestic hogs as a model for feral hogs, conduct a series of experiments to evaluate the use of feed containing gossypol to inhibit reproductive potential  
2. Obtain input from 1) state and federal agencies and 2) collaborators in wildlife biology and population management to prepare for potential future phases of the project

**Progress/Accomplishments:**

In line with Year 1 Objectives, a postdoctoral associate has been hired (to be partially funded by this grant). This postdoctoral associate was selected rather than a graduate student due to current availability and needs of the project. Collaborators met and have initiated plans for development of treatment rations and an initial pilot study. A total of 20 boars have been secured as test subjects for the pilot study. Additionally, working relationships with state and federal agencies and collaborators in wildlife biology and population management have been established and are continuing to be maintained.

**Upcoming Actions/Activities:**

**Treatment Ration Formulation:** A total of four diets with varying gossypol acetate concentrations will be formulated for the pilot study. Specifically, a standard finisher diet (containing corn and soybean meal) will be mixed with gossypol acetate (in a powdered form). A sample of each diet will be sent to collaborators at the USDA ARS Southern Regional Research Center in New Orleans, Louisiana for testing to confirm dietary gossypol acetate concentrations prior to feeding.

**Pilot Study:** A total of four treatments, each with varying concentrations of gossypol acetate, will be assessed in an initial pilot study to determine optimal gossypol concentrations and maximum tolerance. Starting at a body weight of 240 pounds, semen will be collected from boars on a weekly basis to 1) train boars for semen collection and 2) determine sperm concentration as an indicator of sexual maturity. Once a minimum of 16 boars are determined to be sexually mature, the treatment period will start. Specifically, dietary treatments containing varying concentrations of gossypol will be fed up to 45 days. During this treatment period, animal health will be monitored, blood samples will be collected, libido will be assessed, and semen will be collected on a weekly basis. Semen quality measures assessed will include sperm concentration, motility, and morphology. In the event semen quality is negatively impacted, sampling will continue past the conclusion of the treatment period on a weekly basis to determine the duration of treatment effectiveness. This pilot study is scheduled for the spring of 2024.