Soybean science challenge™

Our Soy Checkoff™
Progress Powered by U.S. Farmers

2020 SOYBEAN SCHOLARS

UofA DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

ARKANSAS SOYBEAN PROMOTION BOARD

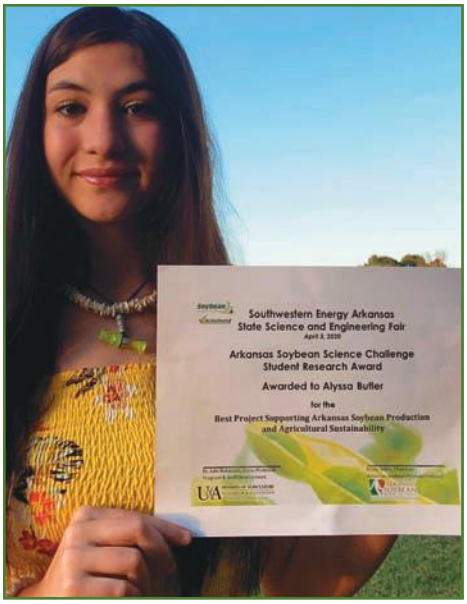
Meet Your 2020 Soy Scholars

The Soybean Science Challenge is a farmer-funded, statewide, high school education program that seeks to increase student knowledge about the value of Arkansas soybeans to the Arkansas economy, to the labor force, and ultimately to feed and fuel the world.

The Challenge is co-sponsored by the Arkansas Soybean Promotion Board and the University of Arkansas System Division of Agriculture Cooperative Extension Service.

In six years the Challenge has reached thousands of students and teachers through real-time and on-line education, in-service training, Virtual Field Trips, classroom lab instruction, Arkansas-based educational publications, mentoring, and awards for independent student research.

Cover photo courtesy of Arkansas Soybean Promotion Board



Alyssa Butler

Virtual Southwestern Energy Arkansas State Science and Engineering Fair First Place Winner

Teacher-Mentor: Carly Bokker
Category: Plant Sciences
School: Carlisle High School, Carlisle, AR

Project Title: Greenhouse Comparison of Genetically Similar Soybean Varieties and Resistance to the Southern Root-Knot Nematode

Abstract:
The southern root-knot nematode (Meloidogyne incognita) is one of the most important yield-limiting plant-parasitic nematodes that affect soybeans (Glycine max) in Arkansas. One of the best management tools that farmers have is host resistance; however, limited information about the host is available. The objective of this study was to evaluate a greenhouse comparison of genetically similar soybean seed varieties. Soybean seed varieties with similar genetic backgrounds that all manufacturers claimed to be moderately resistant to root-knot nematodes, along with one susceptible check (Delta Grow 4880) and one resistant check (Forrest) were used to test nematode resistance and egg reproduction. Plants were planted in a randomized complete block design with five reps and artificially inoculated with 5,000 eggs per plant. Soybeans were rated at 48 days after inoculation, roots were processed to determine eggs per gram. Pioneer P45A45L, Pioneer P43A42X, Pioneer P46T59R and Forrest all were statistically different when compared to the susceptible check (Delta Grow 4880) for root gall ratings; P45A29L and Pioneer P43A42Z were the only two with significant differences in egg/gram root and egg reproduction factor. These varieties were confirmed to be moderately resistant when compared to the resistant check and would be good options for farmers' fields with damaging populations of root-knot nematodes.

Being in a rural county school, farmers are the backbone of our community. Students need to understand in a Plant Science pathway that you can't just decide to plant a bean one day and wait for it to grow. It is such a process, and all the decision making and planning that goes in to producing our crops is a valuable learning tool for students. The Soybean Science Challenge has brought my classroom a new learning tool, not only on the research side but also through information in the learning modules."

– Carly Bokker

Amna Khan

Virtual Southwestern Energy Arkansas State Science and Engineering Fair Second Place winner and Central Arkansas Regional Science and Engineering Fair winner – UA-Little Rock, Little Rock, AR

Teacher-Mentor: Lee Conrad
Category: Energy and Transportation
School: Little Rock Central High School, Little Rock, AR

Project Title: Defatted Soy as a High Performance Energy Storage Material for Super-Capacitors

Abstract:
Soybeans are the largest crops in Arkansas and therefore, its application in the energy sector is vital for the state's economic health. Several soy-based materials (soy meal and defatted form of soymeal soy flour and soy protein) were examined as carbon-based energy storage materials for super-capacitors. A prompt, low cost, single step, green and facile microwave-assisted process was utilized to prepare the carbonized materials. The concentration of doping elements (P and N) was altered by varying the mole ratio of ammonium polyphosphate (APP) in the reaction mixture. The un-doped and doped carbon materials of fatted and defatted soy samples were characterized both physically via BET, XPS and SEM analysis and electrochemically via cyclic voltammetry in both 1M H_2SO_4 and 6M NAOH. Pore size, surface area and elemental compositions of each material were analyzed to investigate the critical parameter of super-capacitor performance of the materials. Furthermore, the capacitance of phosphorus and nitrogen co-doped carbon materials derived from soy samples were calculated and compared. Results suggest that the removal of fats from soy samples improves the capacitance of the materials. Among all materials, defatted soy protein doped with 0.8 g APP exhibited an exceptionally high surface area and high concentration of dope elements. Moreover, the hypothesis is supported that the removal of fat is essential to improve the conductivity of the substance which consequently impacts the specific capacitance of the material.

"Every year, I encourage students to participate in agricultural research, and more specifically, in The Soybean Science Challenge."

– Lee Conrad

Emilee Webb and Taylor Melton

Virtual Southwestern Energy Arkansas Science and Engineering Fair Honorable Mention winners and Ouachita Mountains Regional Science and Engineering Fair winners – Hot Springs, AR

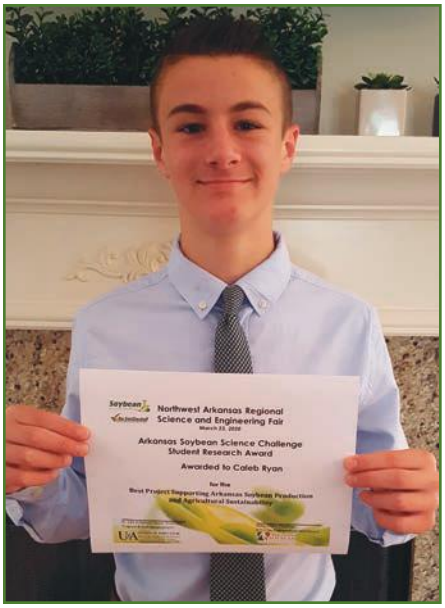
Teacher-Mentor: Amanda Jones
Category: Materials Science
School: Poyen High School, Poyen, AR

Project Title: Deadly Deterioration: What's Really in Your Drink?

Abstract:
Styrofoam may be thought of as a convenient product to make cups, however, what most people do not know is that they are actually consuming part of their cup. After noticing our teacher's drink had obvious holes forming in her cup after drinking limeade, we decided to take a deeper look into what was actually causing this deterioration. To test this, we took Styrofoam cups from a popular fast food restaurant and put the proportional amount of lemons or limes in each cup that the restaurant would put in. Soda and water were also tested with water as the control. After just one hour, holes in the cups with the lemons and limes began to form. This Styrofoam is now part of the drink. The World Health Organization has recently named Styrofoam as a probable carcinogen. To prevent this harmful substance from leaking into drinks, we believed soybean oil would produce a protective coat on the cup. When a soybean coating surrounded the interior of the cup, no holes formed after one hour. After 24 hours, only a few holes formed and not every cup had holes. Soybean oil is a cheap, tasteless and odorless protectant that may prevent a toxic buildup of styrene within humans. Based on the data gathered from the experiment, several specimens of interest were identified that will undergo further testing to determine the mechanism by which the microorganism affects the pathogen and from there in vitro tissue trials.

"Emilee and Taylor both gained a wealth of knowledge about soybeans and how they affect our state's economy by taking the online course as part of The Soybean Science Challenge. The entire process was a wonderful experience for each of them as they learned about the importance of research, product development and the scientific process."

– Amanda Jones



Caleb Ryan

Virtual Northwest Arkansas Regional Science and Engineering Fair winner – UA Fayetteville, Fayetteville, AR

Teacher-Mentor: Jennifer Main
Category: Plant Sciences
School: Providence Classical Christian Academy, Rogers, AR

Project Title: Enhancing Soybean Growth through the Use of Magnetic Fields

Abstract:
As the world's population continues to grow, it is important for the agriculture industry to discover ways to keep up with this growth. This project explores how magnetic fields enhance crop growth, particularly when it comes to soybeans. The hypothesis of this experiment was that when magnets are positioned around soybean plants, creating a magnetic field, the plants' growth will be enhanced. There has been much previous research supporting this assertion with other plant species. After five soybean seeds were placed in eight 5.5-inch tall pots, two groups were created, the control group and the variable group, each containing four pots. The control group was given no factors, while the variable group was given two disc magnets on either side of the pots and both were tested for 40 days, with data collected daily. At the end of the 40 days, the average height of the control group was 23.03 cm while the variable group had an average height of 33.15 cm. This data, along with the rest of the data from the experiment, suggested that the hypothesis was supported since the soybean plants in the variable group (group with magnets) grew far faster than those in the control group (group without magnets).

"I told all of my students that if they were interested in a science fair project dealing with plants, they could choose to work with soybeans since they are an important plant within the state of Arkansas."

– Jennifer Main

Cooper Bassham

Northeast Arkansas Regional Science Fair winner – ASU, Jonesboro, AR

Teacher-Mentor: Amanda Smith
Category: Materials Science
School: Salem High School, Salem, AR

Project Title: Utilizing Desk Top Fabricated Sensors to Measure Transpiration Rates in Glycine Max

Abstract:

Purpose: the focus of this experiment was to find a more cost effective and accurate method for analyzing transpiration rates in soybeans (Glycine max). By using three-dimensional printing technology and low-cost electrical components, the data collection process will become much cheaper and less labor intensive.

Method: An Arduino board was attached to three probes, each consisting of thermocouple wire. These probes were inserted into soybean stems and a system was designed to deliver a heat pulse at regular intervals, then recorded the time it took for the pulse to reach a heat detection probe. This time frame over a known distance is how the transpiration measurements are taken.

Data: The field data recorded between April 8, 2019 and May 30, 2019 utilizing the eddy covariance method indicated that the average hourly transpiration rate was 0.14 mm/hour and the average daily transpiration rate was 3.27 mm/day. Hummingbird Arduino records temperature.

Conclusion: the results of this study are intended to increase the sample size of individual measurements, creating an overall more accurate view of a region's irrigation requirements rather than small, representative samples of the entire area's requirements and therefore increase aquifer conservation and economic returns. The results of this study on the plant scale will inform field scale evapo-transpiration rates in the region. Testing has revealed that the sensors do indeed record transpiration, supporting my hypothesis that a partially 3D printed sensor is a contender for a less expensive yet practical transpiration measurement method.

"Because of the Soybean Science Challenge, I have gained more knowledge about soybean production in Arkansas. I have a great respect for farmers in my home state that are encouraging students to participate in science fair with agricultural type projects which benefits us all!"

– Amanda Smith

Joshua Bryant

ASMSA, West Central Region Science Fair winner – Arkansas School for Mathematics, Sciences and the Arts, Hot Springs, AR

Teacher-Mentor: Shane Thompson
Category: Material Sciences
School: Arkansas School for Mathematics, Sciences and the Arts, Hot Springs, AR

Project Title: Building the Future, Soybean Waste Construction Material

Abstract:
A soybean hull is the thin outer layer of a soybean. Soybean hulls are a by-product of soybean processing facilities. The soybean hulls have limited uses and are often discarded or fed to livestock. This project is an attempt to create a use for soybean hulls while eliminating the use of nonrenewable or severely depleted resources. The soybean hulls were procured from a facility in Helena, Arkansas. Two 19 Liter buckets were fill with soybean hulls and several containers of water-based adhesive. The soybean hulls and the water-based adhesive were combined to form a sheet of material. A separate sample of soybean hulls was also combined with a non-environmentally friendly adhesive to determine whether water-based adhesives were effective. The soybean hull sheets were placed under stress to determine its resistance to weight. The soybean material data that was recorded was compared to data collected for other materials. The data showed soybean material is too low stress-wise to be considered for building but would make a decent substitute for cork.

"I appreciate the Soybean Science Challenge for Arkansas students to see a very valuable resource of Arkansas."
– Shane Thompson

Natalie Blake

Virtual Southeast Regional
Arkansas winner

Teacher-Mentor: Shannon Blake
Category: Plant Sciences
School: Star City High School,
Star City, AR

Project Title: Induced Leaching of High Sodium Water out of Root Uptake Zone of Glycine Max by Ionization

Abstract:

Research Question: The research question for this project is 'How will the electromagnets ionization of salt water affect the depth of saline in the soil?'

Hypothesis: Ionization of salt water will increase leaching to lower depths of the soil which will avoid the root uptake of Glycine max.

Procedure: The student planted multiple varieties of Glycine max to grow to adults. An average root length was taken from the plants. Next the student built an electromagnetic pump for irrigation. The hose was fitted into the pump. A copper coil was wound around the hose forming a solenoid. The ends were attached to a battery during watering to ionize the saline water. Three 40 cm pots were filled with dirt. The student watered the three pots, one with 1000 mg saline to 1L of water (1000 ppm concentration), one control with plain water and one with 1000 ppm saline run through an electromagnetic pump. The pots were watered with these concentrations and allowed to dry between watering. After one week, samples were taken from the soil removed one layer at a time and tested with the saline meter.

Results: The pot of soil irrigated with the electromagnet had a lower concentration of salt in the level of the root uptake zone.

Conclusion: Evidence suggested that the hypothesis was correct in that the ionization of salt water will increase leaching to lower depths of the soil which will avoid the root uptake zone of Glycine max.

"By competing in the Soybean Science Challenge, Natalie has gained confidence in her ability to become part of a community of scientists, teachers or engineers. The possibilities are endless."

– Shannon Blake

Tori Mattmiller

Southwest Arkansas Regional Science Fair winner – SAU, Magnolia, AR

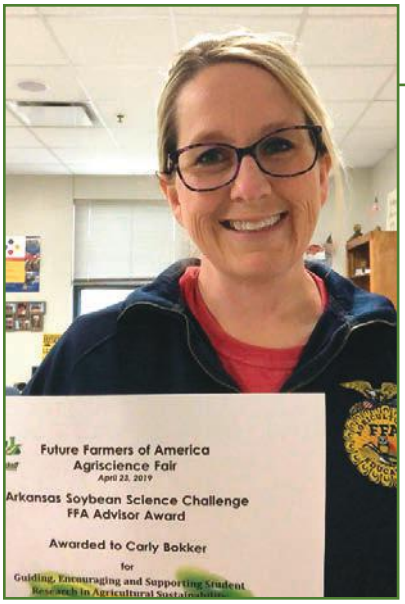
Teacher-Mentor: Connie Orsak
Category: Agriculture, Earth and Environmental Sciences
School: Emerson High School, Emerson, AR

Project Title: The Effect of Acid Rain on Soybean Root Modules

Abstract:
Farmers have started using rhizobia bacteria-based inoculants to fertilize their soybeans. The rhizobia bacteria create a symbiosis relationship with the legume causing root nodules on the plant. In Arkansas, most of the farmland used to grow crops has acidic soil. Could the acidic soil have an effect on the symbiosis relationship the bacteria and plant have? Can a low pH balance caused by acid rain affect the amount of soybean root nodules? It was determined that a low pH balance could ultimately decrease the amount of root nodules on the soybean. To test this theory, the soybeans were grown using inoculants (rhizobia bacteria); half of the plants were watered with distilled water (control group) while the other half were watered with acidic rain solution (manipulated). After three weeks the plants were taken out of the soil (roots intact), the soybeans were tested by how much area the nodules took up on graph paper. The data proved that low pH balance caused by acid rain decreases the amount of soybean root nodules. The control group had an average area of 8.3% occupied by root nodules; the manipulated group had an average of 4.1% occupied by root nodules. The experiment supported the claim that a low pH balance causes less soybean root nodules. The data found during this experiment can be used to help farmers make intelligent decisions when it comes to using rhizobia bacteria inoculant to fertilize their acidic soil.

"I have gained an appreciation for the efforts of the Soybean Science Challenge in trying to improve the education of our students in Arkansas."

– Connie Orsak



Alyssa Butler

Virtual FFA Arkansas State Agriscience Fair Soybean Science Challenge Winner

FFA Advisor: Carly Bokker
Category: Plant Sciences
School: Carlisle High School, Carlisle, AR

Project Title: Greenhouse Comparison of Genetically Similar Soybean Varieties and Resistance to the Southern Root-Knot Nematode

Abstract:
The southern root-knot nematode (Meloidogyne incognita) is one of the most important yield-limiting plant-parasitic nematodes that affect soybeans (Glycine max) in Arkansas. One of the best management tools that farmers have is host resistance; however, limited information about the host is available. The objective of this study was to evaluate a greenhouse comparison of genetically similar soybean seed varieties. Soybean seed varieties with similar genetic backgrounds that all manufacturers claimed to be moderately resistant to root-knot nematodes, along with one susceptible check (Delta Grow 4880) and one resistant check (Forrest) were used to test nematode resistance and egg reproduction. Plants were planted in a randomized complete block design with five reps and artificially inoculated with 5,000 eggs per plant. Soybeans were rated at 48 days after inoculation, roots were processed to determine eggs per gram. Pioneer P45A45L, Pioneer P43A42X, Pioneer P46T59R and Forrest all were statistically different when compared to the susceptible check (Delta Grow 4880) for root gall ratings; P45A29L and Pioneer P43A42Z were the only two with significant differences in egg/gram root and egg reproduction factor. These varieties were confirmed to be moderately resistant when compared to the resistant check and would be good options for farmers' fields with damaging populations of root-knot nematodes.

"The learning modules for the Soybean Science Challenge online are a great teaching tool for me in the classroom. Being from a strong farming community, the material is timely and relevant to our local needs."

– Carly Bokker

Other Project Finalists

2020 Regional and State Science Fairs

ASMSA West Central Region Science Fair

Arkansas School for Mathematics, Sciences and the Arts, Hot Springs, AR
Michael J.: Project Title: "Using Drones to Plant Soybeans"
Xander A.: Project Title: "Scarification and Soybean Growth"

Central Arkansas Regional Science and Engineering Fair

Carlisle High School, Carlisle, AR
Alyssa Butler: Project Title: "Greenhouse Comparison of Genetically Similar Soybean Varieties and Resistance to the Southern Root-Knot Nematode"

Clinton High School, Clinton, AR
Ashlyn Watson: Project Title: "Sound of Growing"

Pottsville High School, Pottsville, AR
Isaac Mays: Project Title: "Optimal Moisture for Growing Soybeans"
Zino Schroeder: Project Title: "Building with Soybean-Based Ingredients"

Ouachita Mountains Regional Science and Engineering Fair

Poyen High School, Poyen, AR
Lance Austin and Karis Sullivan: Project Title: "SOYA Wanna Recycle Water"

Glen Rose High School, Malvern, AR
Diana and Olivia Taylor: Project Title: "Waste Not, Want Not: Making Paper from Soybean Waste"

Virtural Northwest Arkansas Regional Science and Engineering Fair

Fayetteville Christian Academy, Fayetteville, AR
Johnathan Gonzales: Project Title: "Is Bleached Induced Germination More Effective for Soybean Growth?"

Alma High School, Alma, AR
Magalie Higgins: Project Title: "Making Water Work"
Molly Reeves: Project Title: "Grow Like a Pro with Probiotics Phase IV"

Northeast Regional Science and Engineering Fair

Nettleton High School, Nettleton, AR
Jayden Turner: Project Title: "Absorption of Radiant Energy using Different Colors"

Jonesboro High School, Jonesboro, AR
Annika Acebo: Project Title: "Searching for Soybeans through Mapping"
Madison Shelton: Project Title: "Turning Soy into Joy for Ducks"

Southwest Arkansas Regional Science Fair

Taylor High School, Taylor, AR
Will Barton: Project Title: "The Effect of Vitamin D on Root Growth of Soybeans"

Virtual Southeast Arkansas Region

Pine Bluff High School, Pine Bluff, AR
Corrissa Berrien: Project Title: "Speed It Up!"
Jordan Harris: Project Title: "Is Gray Water Right for Plants?"

Virtual FFA State Agriscience Fair

Taylor High School, Taylor, AR
Will Barton: Project Title: "The Effect of Vitamin D on Root Growth of Soybeans"

Bergman High School, Bergman, AR
Elle and Devin Jackson: Project Title: "Polluted vs Non-polluted Soil Amendments"

Soybean science challenge™

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www.uaex.edu/soywhatsup

U of A Division of Agriculture Research & Extension University of Arkansas System

Arkansas Soybean Promotion Board

Free Educational Resources and Materials Available from the Soybean Science Challenge at www.uaex.edu/soywhatsup

The Arkansas Soybean Science Challenge is a science enrichment program open to students in grades 9-12.

The Arkansas Soybean Science Challenge research program includes:

- $300 cash awards for high school student science projects impacting sustainability at Arkansas regional science fairs and Arkansas FFA Agriscience Fair; $1000 first place, $500 second place and $250 Honorable Mention at the Arkansas state science fair.
- $200 cash awards to teachers whose students win the Soybean Science Challenge at regional. Teacher awards at state are $300 for first place, $200 for second place and $100 for Honorable Mention.

STUDENT ONLINE COURSE – 6 MODULES

- The Science of Soybean Production
- The Miracle Bean: Food
- The Miracle Bean: Fuel
- The Miracle Bean: Feed
- The Faces & Challenges of Farming: Emerging Issues
- Ready…Set…Research!

9-12th grade students who successfully complete the Soybean Science Challenge online course and enter a soybean-related project in one of the Arkansas regional and state science fairs, and FFA Agriscience Fair are eligible to have their projects judged for cash awards.

For more information about the Soybean Science Challenge Program, contact:
Dr. Julie Robinson (jrobinson@uaex.edu)
Diedre Young (dyoung@uaex.edu)
Phone 501-671-2086

FREE CLASSROOM RESOURCES

Teacher In-Service Online Course
7 Hours ADE Approved – 6 Modules

Teacher Resources Course for Classroom Use
6 Modules, Tests, Answer Keys and over 50 other soybean-related articles and resources

Teacher Classroom Lessons in 7E & GRC-3D (NGSS Aligned) Format

High School Science Curriculum Resource Guide

Arkansas High School Science Project Development Guide

Soybean Science Challenge Brochure

Free Soybean Science Challenge Seed Store for Student Research Projects

Several Virtual Field Trip videos that include Teacher Guides

Soybean science challenge

Our Soy Checkoff™
Progress Powered by U.S. Farmers

Harvesting the potential of Arkansas' young scientists!

The GOAL of the Arkansas Soybean Science Challenge is to engage high school science students in "real-world" education to support soybean production and agricultural sustainability and to reward scientific inquiry and discovery that supports the Arkansas soybean industry.

Learn more at: www.uaex.edu/soywhatsup

Funding provided by:

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION
University of Arkansas System

ARKANSAS SOYBEAN PROMOTION BOARD

Cultivating Arkansas' student scientists to change the world