

Extension & Outreach Newsletter

January 2021; Volume 2, Issue 1

HIGHLIGHTS

Noteworthy

> Page 1

Accomplishments

> Page 1

SBAR StoryMap

> Page 1

Grower Updates: Guar

> Page 2 & 3

Grower Updates: Guayule

> Page 3 & 4

Youth Outreach

> Page 4

Get Involved

> Page 4

Educator Resources

> Page 4

Coming Soon

> Page 5

Contact Info

> Page 5

NOTEWORTHY & NEWSY



Dr. Frannie Miller

New Mexico State University Assistant Professor in the Department of Agricultural Economics and Agricultural Business.

Frannie joined the SBAR Youth Outreach Team and will develop activities to engage 4-H participants.



Mr. Alan Daugherty

Science teacher at Melrose Jr. High and High School in Melrose, NM., and a 2019 Excellence in STEM Award recipient.

Alan joined the Education Team and will bring SBAR themed lessons into his middle school science classroom.

Accomplishments

Education Fellow Arisbeth Ibarra Nieblas won 2nd place at the 2020 American Institute of Chemical Engineers K-12 STEM Outreach Competition for her lesson "Exploring Bioproducts: Glue for Piñatas" - read more [HERE](#)

Extension Team Lead Blase Evancho hosted the Guayule Field Day in October 2020 with Bridgestone Americas and the UArizona Extension Office. Learn about guayule research and production and watch the Field Day presentations [HERE](#)

SBAR goes virtual in 2020! Read about our progress, learn about our next steps, and watch the Annual Retreat student research presentations [HERE](#)

SBAR StoryMap: A Guayule and Guar Story

As the SBAR Center of Excellence embarks on the 4th year of research, development, deployment, and community engagement, the team's accomplishments are highlighted in a new SBAR Accomplishments ArcGIS StoryMap available to the public. Some questions remain (and some new ones have been uncovered), but we are making progress toward achieving the mission to build a sustainable bioeconomy in arid regions of the Southwest! Explore the progress we've made and share the link with your colleagues! Check out our story [HERE](#)

Guar in New Mexico

FIELD DAYS

Due to COVID-19 restrictions, many Field Day events were postponed. However, Dr. John Idowu, NMSU Extension Lead, presented at the 2020 Virtual Field Day hosted at the Rex E. Kirksey Agricultural Science Center at Tucumcari, NM. SBAR research was presented in his talk: The Potential of Guar for Eastern New Mexico. Watch John's talk [HERE](#)

DEMONSTRATION TRIALS

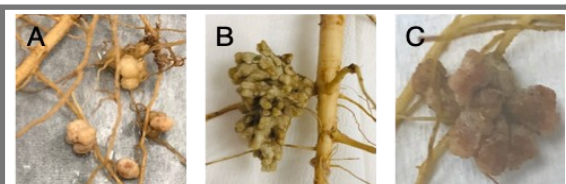
Demonstration trials were conducted on guar's response to limited irrigation in Las Cruces, NM, and Artesia, NM. Field trials evaluated plant characteristics that determine seed yield, agronomic and physiological response of guar genotypes under five drip-irrigated water regimes, and plant response with and without biogenic silica application. Biogenic silica is a naturally deposited material that can be mined and applied to the soil. It is a powdery material that has been shown to increase the soil water holding capacity, thus helping crops to be more drought resistant. In general, the I1 regime (irrigation through the entire season) produced the highest guar seed yield followed by I5 regime (terminate irrigation at flowering + biogenic silica) in Las Cruces (2016-2018) and in Artesia (2018). As compared to the I1 regime (normal irrigation), the I2 regime (no irrigation at 75% pod formation) and I3 regime (no irrigation at 50% and 75% pod formation) resulted in 20.8 % and 23.4% decline in guar seed yield, respectively. The lowest seed yield was obtained under I4 regime (terminate irrigation at flowering) which resulted in 26.4% decline in seed yield as compared to the I1 regime (irrigation through entire season). The I5 regime (terminate irrigation at flowering + biogenic silica) resulted in 17.3% higher seed yield as compared to the I4 regime (terminate irrigation at flowering) at Las Cruces. Results indicated a positive impact of biogenic silica on guar growth and seed yield under limited irrigation conditions. Dr. Kulbhushan Grover reported results.



Dr. Grover harvesting guar with students (Tucumcari, NM, Dec, 2019)

IDENTIFICATION OF *RHIZOBIUM* AND OTHER SYMBIOTIC BACTERIA IN NODULES OF GUAR IN NEW MEXICO

Guar (*Cyamopsis tetragloba* L.) is a drought-tolerant legume that produces seeds rich in galactomannan or guar gum, a polysaccharide used as a lubricant, binder, food thickener, or hardener. Like other legumes, guar associates with symbiotic nitrogen-fixing rhizobia bacteria and form root nodules. The symbiotic nodules are specialized root organs that house rhizobia capable of using nitrogen gas (N_2) diffused into the soil from the air to produce organic nitrogen that the plant can use to grow. The rhizobia in the root nodules convert N_2 in the soil to ammonia, which is then taken up by plants to synthesize amino acids and other nitrogen compounds.



Determinate

Indeterminate

Nodules from guar plants grown at the Leyendecker, Fabian Garcia, and Los Lunas (A, B, C) Agricultural Science Centers in NM. Two types of guar nodules were identified: Determinate and indeterminate.

the SBAR Characterizations and Co-Products team, who isolated the symbiotic bacteria from the guar nodules.

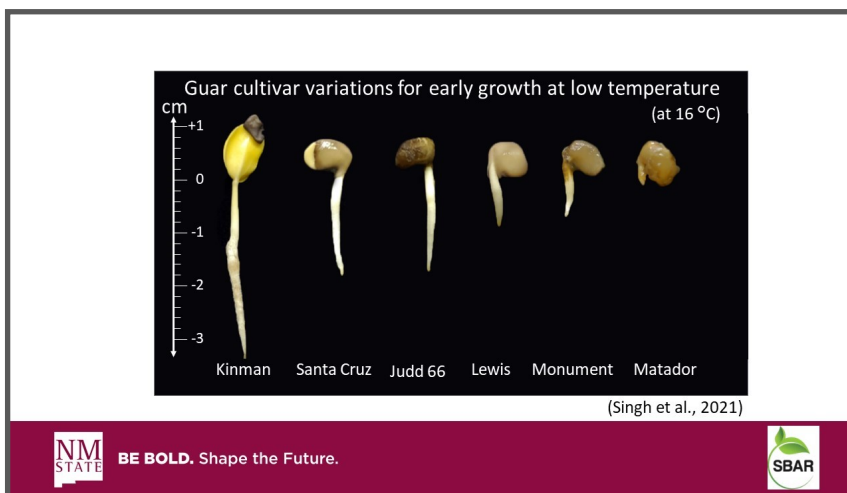
Three species of bacteria other than rhizobia were also identified: *Pseudomonas*, *Bordetella*, and *Agrobacterium*. Identifying the *Rhizobia* species associated with guar nodulation in NM will assist in optimizing the production of guar in the Southwest. The bacteria in nodules of different guar varieties shows that a diverse population of bacteria reside within the guar nodules. These bacteria may not be capable of fixing nitrogen but can potentially enhance legume survival, especially under environmental stress conditions.

The identified nodule associated bacteria could be used as bio-inoculants combined with *Rhizobia* to study their ability to enhance nodulation, rhizobial performance or persistence, and reduce chemical use fertilizers and pesticides for guar. Dr. Laura Rodriguez-Urbe reported results.

Guar in New Mexico

PROPER CULTIVAR SELECTION HELPS IN PLANTING GUAR IN COOLER REGIONS

Domestic supply of guar is becoming more important in the US to meet growing demand by diverse industries and to buffer supply uncertainty. Guar is a desert adapted crop and is well suited for New Mexico and Arizona. However, guar is grown in warmer regions of the world. Therefore, we studied germination and early growth of currently available guar cultivars under a range of temperatures to identify suitable cultivars for lower temperatures to potentially expand guar production to cooler regions. Lowering the temperature from 28 to 13°C decreased the overall final seed germination percentage, seed vigor index, primary root length, and speed of germination index in most of the cultivars. However, Kinman cultivar maintained a longer root and recorded higher values for most of the vigor indices at cooler temperatures. Matador cultivar had the lowest values for most of the vigor indices throughout the experiment. Results indicate with proper cultivar selection, guar area can be extended to colder regions. Kinman cultivar can be used in the cooler regions of the Southern High Plains of USA. Jagdeep Singh and Dr. Sangu Angadi reported results.



Guayule in New Mexico

COLD-ACCLIMATION AND FREEZING IN GUAYULE

A recently completed study analyzed the metabolome of leaves of the guayule germplasms AZ-2 and W6-429 exposed to cold-acclimation and freezing temperatures. Dr. Rodriguez-Urbe, a molecular biologist and research Assistant Professor in the Department of Plant and Environmental Sciences and a member of the SBAR Characterization and Co-Products research team, used the guayule metabolomes to identify metabolic biomarkers for cold-acclimation and freezing. Dr. Rodriguez-Urbe produced the manuscript “Untargeted metabolome profiling of guayule (*Parthenium argentatum* A. Gray) to identify metabolic biomarkers for cold-acclimation and freezing temperature tolerance” that includes the guayule metabolomes and metabolic biomarkers. This manuscript is the first report of metabolome profiles from leaves of the USDA guayule germplasms, polyploid AZ-2, and diploid W6-429 in cold-acclimation and freezing. It is also the first report on the identification of metabolic biomarkers associated with these environments. The manuscript is expected to be published in the Industrial Crops and Products peer-reviewed journal soon.



A six months old guayule W6-429 seedling grown in greenhouse at 38/23°C day/night.



Three guayule germplasms with mature plants in the field identified to have a low cold injury in Las Cruces.



A follow-up study on the guayule temperature response in leaf and bark tissues is underway to gather information on the possible sequence of events leading to rubber biosynthesis and accumulation. Three germplasm groups with mature plants in the field that Bridgestone identified to have a low cold injury in Las Cruces are being studied for their metabolic and transcriptomic response to decreasing clinal temperature. The initial samples were collected by the graduate student Ujala Sehar in September. Subsequent monthly sample collection will be carried out up to March 2021. Dr. Laura Rodriguez-Urbe reported results.

Grower Updates: Guayule Research & Activities

Guayule in Arizona



✱ Denotes SBAR or Bridgestone plot with guayule trials

FIELD DAYS

The 2020 Virtual Guayule Field Day brought together people from all over the world to learn about guayule! The field day, originally scheduled for early summer was postponed by COVID-19. The UArizona SBAR Extension Team transitioned the event to a virtual platform and hosted over 100 people from 5 states and 2 countries and featuring several presentations discussing guayule production. We were fortunate to have presentations from University of Arizona Extension Specialists, Bridgestone researchers and SBAR researchers discussing insect pests, agronomic production, weed control and economic outlook for guayule. View presentations by Dr. Bill McCloskey on weed control, Trent Teegerstrom on guayule crop budgets, and others [HERE](#)

We thank everyone for attending and look forward to an in person field day next year.

Get Involved: Youth Outreach

INTERN WITH SBAR IN SUMMER 2021

OPEN TO HIGH SCHOOL STUDENTS IN ARIZONA

Interns gain valuable field skills while spending time with industry chemists, geneticists, engineers, or other research scientists at the University of Arizona. Interns are required to make a scientific poster about the research that they conduct during their internship, which will be presented at the 2021 SBAR Retreat in Tucson, AZ.

Learn more [HERE](#)



SBAR interns at Agriculture Field Day Event

SBAR JUNIOR AND SENIOR SUMMER INTERNSHIPS 2021

Spend 2-weeks (Junior Intern) or 8-weeks (Senior Intern) this summer with industry chemists, geneticists, engineers or research scientists at a University of Arizona or in an agriculture & biotechnology research lab! Opportunities include hands-on environmental science research, education, outreach and the chance to shadow a real scientist and see if that is a career for you!

WHAT'S IN IT FOR ME?

- Gain valuable field and laboratory skills in a once in a lifetime experience
- Receive a \$3000 scholarship to pay for tuition
- See what it's like to be in a career and help improve the lives of others!
- Make practical use of what you learned in school by doing field or lab research in one of the following areas:
 - Soil science
 - Engineering, Bioengineering
 - Microbiology
 - Molecular Biology
 - Plant genetics
 - Integrated Pest Management
 - Crop science
 - Economics of Agriculture
 - Biofuels
 - Agricultural Education
 - Biotechnology
 - Environmental science

APPLICATION DEADLINE
2/25/2021



SUSTAINABLE BIOECONOMY
FOR ARID REGIONS

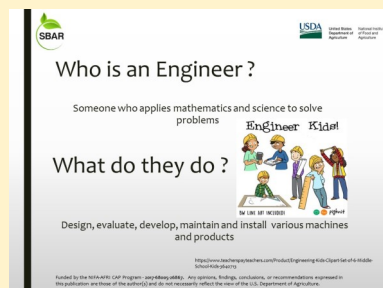


WHAT'S EXPECTED OF ME?

- Have reliable transportation
- Be on time everyday, M-TH for 2-weeks or 8-weeks
- Follow directions and ask questions if you're unsure
- Be honest, be responsible if you make a mistake
- Keep a lab notebook or journal up to date
- Learn how to follow safety procedures
- Most of all, have a passion for learning, an interest in agriculture, and a desire to be part of a professional team that helps improve people's lives!

SBAR Content with 4-H

University of Arizona 4-H Youth Development Resources



Check out SBAR 4-H virtual programming, camps and curriculum, and get involved [HERE](#)

4-H Ambassador Program

SBAR partners with 4-H Ambassadors, a leadership experience for 4-H teens.

Get involved [HERE](#)

Guardians of the Biosphere After School Clubs

Coming soon! Create a "GOB" club at your school with content by SBAR 4-H. Initiated by New Mexico science educators Cathy Bradley and Tracie Mikesell. Watch a GOB blurb [HERE](#)

SBAR Content with FFA

Future Farmers of America

New Mexico State University researchers and educators have created SBAR lessons and activities for FFA.

Check out content and get involved [HERE](#)



Educator Resources

EDUCATION DIGITAL CORNER

The SBAR Education Partnership offers a digital treasure trove of lessons, activities, videos and graduate students to support educators in creating and teaching arid regions themed lessons. Learn more from the interactive Story Map.

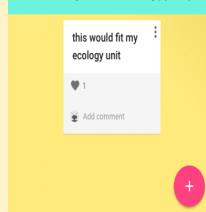
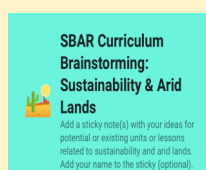
SBAR [Story Map](#) Orientation— created by Education Researcher Corey Knox, PhD



Images from SBAR Story Map



Let's Brainstorm Curricular Connections!
Think about the STEM sequence of topics you teach in a given year. How can current research from our region, and current environmental concerns be integrated into your teaching? Below are five interactive brainstorming boards where you can to share your ideas about the connections of SBAR themes and your own.



SBAR Education Partnership

We are expanding our Education reach by going statewide and virtual. SBAR curricula align with NGSS and focus on FIVE main areas that connect to SBAR Research:

- > Arid Lands, Agriculture & Sustainability
- > Land Use, Farming & Culture in Arid Regions
- > Building Bioeconomy in Arid Regions
- > Sustainable Crops: Guar & Guayule
- > Chemistry & Engineering

Hear what teachers say about SBAR

[HERE](#)



Virtual SBAR Education Content

[DOWNLOAD AND USE SBAR THEMED LESSONS, VIDEOS AND ACTIVITIES HERE](#)

Plant Adaptations for Arid Lands

Authors: Fred Goss and Matthew W. Johnson

Standards

- MS-LS1-1: Engage in argument from evidence to support a claim about the factors that drive changes in biological systems.
- MS-LS1-2: Analyze and interpret data to show relationships between variables in a system.
- MS-LS1-3: Analyze and interpret data to show relationships between variables in a system.

Materials

- PowerPoint: Plant Adaptations for Arid Lands
- Poster
- Colored Pencils

Set Up

Plan for either digital access or access to live plants: saguaro, creosote, palo verde, ocotillo, mesquite, guar and guayule. If you are able to take the class outside, be ready to identify and explain to students the adaptations of each plant. For a home schooling adaptation, you may ask students to identify these plants in their own yards or neighborhoods by taking a photo and sharing.

For online presentations, follow the notes in this lesson plan and process outlined on each slide of the PowerPoint presentation. Live presenting the lesson to the students via a Zoom session is a much more effective way of disseminating the material than providing pre-recorded material.

Lesson Procedure

Follow the PowerPoint as a guide to the lesson.

Step 1: Introduction (5 minutes)

Conduct a think, pair, and share using the following question as shown on the PowerPoint slide 2: **What are some of the ways plants have adapted to living in an arid (dry) place?** After students discuss this question with their groups, ask the class to share possible answers. The expected answers include the following ideas:

Guayule in a Bottle

Authors: Priscilla Fackrell & Emily Warren, M.S.

Standards

- MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-LS4-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Materials/Resources

- PowerPoint 1: Guayule in a Bottle
- Handout 1: Observation Sheet (attached)
- Handout 2: Experiment Conclusion (attached)
- 3 plastic bottles
- 1 bottle cap
- Soil
- Cotton String
- Nail
- Scissors
- Duct Tape
- Seedlings—Guayule (or other low water plants), tomatoes, corn, brassica sprouts, lettuce, and/or other vegetable seedlings
- 1-2 heating lamps (if the classroom does not have natural light available)

Lesson Overview

In this lesson over two week lesson, students will use the scientific process to conduct an experiment comparing a high water use seedling and a low water drought resistant plant (Guayule). The growing and observation process can last from 1-2 weeks, with daily observations—see the attached Handout 1 (Daily Observation Sheet). Final discussion questions and a conclusion report outline are included in the PowerPoint for this lesson and on the attached Handout 2.

Learning Objectives

- Students will learn about Guayule and other arid land crops.
- Students will be able to identify quantitative and qualitative changes in the bottle ecosystems.
- Students will increase their understanding of water usage and the implications to crops in arid regions.
- Students will be able to explain environmental characteristics that support or hinder the growth of particular plants.
- Students will implement data collection methods for monitoring and analyzing growth patterns.
- Students will be able to construct scientific arguments based on data collected and analyzed.

Example: PowerPoint Presentation on Materials

Diagram: Copyright, Geed Hill, Ph.D. College of Engineering, University of Colorado Boulder

Agriculture, Bioproducts, and Bioeconomy

January 2020

At the end of today, we will be able to...

1. Define agriculture.
2. Describe growing conditions in the Sonoran Desert.



November 1, 2018
Desert Ecosystem

What is the difference between abiotic and biotic factors?

Abiotic Factor

- Non-living components of an ecosystem

Biotic Factor

- Living components of an ecosystem

These images are a few examples of the lesson plans, power point presentations and videos available for free download.

Educators Join SBAR today! Fill out an Interest Form [HERE](#)

COMING SOON!

Recruiting: Growers

SBAR is seeking growers for trial plots of guar (NM) or guayule (AZ)

Available Spring 2021

Contact: John Idowu (Guar, NM)

Contact: Blase Evancho (Guayule, AZ)

Recruiting: Educators

SBAR is seeking educators for virtual partnership

Available Fall 2021

Contact: Catie Brewer (NM)

Contact: Corey Knox (AZ)

Recruiting: 4-H Volunteers

SBAR is seeking community members as 4-H volunteers

Available Fall 2021

Contact: Laura Rodriguez-Urbe (NM)

Contact: Nick Morris (AZ)

USDA Plant Guide on Guayule

Available Spring 2021

Contact: Blase Evancho

SBAR Plant Guide on Guar

Available Spring 2021

Contact: John Idowu

SBAR Whole Farm Analysis Tool

for Evaluating the Adoption of Guayule and Guar into Your Current Operation

Available Spring 2021

Contact: Trent Teegerstrom

Contact Our Team

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We would love to hear from you!

Sign up for the SBAR List to receive our Newsletter and email updates. Email sbar-outreach@list.arizona.edu with SUBSCRIBE on the subject line.

Check out the SBAR website for more information, videos, publications and resources: <https://sbar.arizona.edu>

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SUSTAINABLE BIOECONOMY
FOR ARID REGIONS



United States
Department of
Agriculture



National Institute
of Food and
Agriculture



Colorado State University



Agricultural
Research
Service



COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT



THE UNIVERSITY OF ARIZONA
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