



SUSTAINABLE BIOECONOMY
FOR ARID REGIONS

COMPREHENSIVE EVALUATION OF USDA GUAYULE GERmplasm IN ARIZONA



LEARN MORE

- > A desert-adapted shrub
- > Requires less water than current crops
- > Water for irrigation is a limiting factor
- > Rubber is the economic driver for commercialization
- > Co-products will help increase the economic base
- > Resins for varnishes, coatings, adhesives, insecticides

GUAYULE GERmplasm ACCESSIONS

- > The USDA guayule germplasm collection is made up of accessions within *Parthenium argentatum* (pure guayule), interspecific hybrids between guayule and other *Parthenium* species, and other related species in the genus *Parthenium* (e.g., *P. incanum*, *P. stramonium*, and *P. tomentosum*).
- > Forty-five guayule germplasm accessions were planted at the Bridgestone Americas, Inc. Guayule Research Farm, Eloy, AZ, and the University of Arizona, Maricopa Agricultural Center, Maricopa, AZ. These two locations are about 35 miles apart, with very similar climatic conditions, but different soil types (clay and sandy clay loam, respectively).

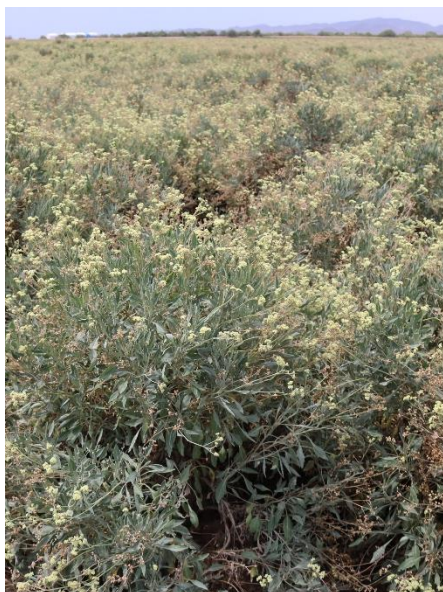
Table 1: Climatic and soil characteristics for the two locations of the Guayule Regional Yield Trials

	Eloy	Maricopa
Location	Bridgestone Americas, Inc. Guayule Research Farm 32°40'N 111°37'W 1,555 ft above sea level	The University of Arizona, Maricopa Agricultural Center 33°04'N 111°58'W 1,184 ft above sea level
Maximum summer temperatures	Above 104°F	Above 104°F
Minimum winter temperatures	Below 32°F	Below 32°F
Rainfall 04/2018 to 04/2020	17.3 in	17.2 in
Irrigation	Sprinkler + Furrow Irrigation	Sprinkler + Furrow Irrigation
Soil Type	Clay loam Gadsden series, pH = 8.4	Sandy loam Casa Grande series, pH = 8.2

- > The 45 guayule germplasm accessions were direct-seeded at each location in April 2018 and harvested in May 2020. The plants harvested in each plot were evaluated for biomass yield (lb/ac), resin content (%), resin yield (lb/ac), rubber content (%), and rubber yield (lb/ac).

STUDY RESULTS

- > Stands established via direct seeding
- > Higher biomass production in heavier soil
- > Diversity found in all traits
- > Much potential to improve yield characteristics
- > AZ-2 yields well at both locations
- > Moderate biomass desired until its economic value determined



> The goals of the Comprehensive Evaluation of USDA Guayule Germplasm in Arizona were to assess how the 45 different guayule germplasm accessions perform: (1) when stands are established via direct-seeding (previous trials were established with transplants), and (2) how different soil types affect biomass, rubber, and resin production.

BIOMASS PRODUCTION

> Average biomass production was greater at Eloy than at Maricopa (Table 2), and biomass production has the highest correlation with rubber and resin yield (Dierig et al., 1989). Thus, even though rubber and resin content are essentially the same at both locations, rubber and resin yields are greater at Eloy.

Table 2: Average biomass yield, resin content, resin yield, rubber content, and rubber yield at Eloy and Maricopa, AZ.

		Eloy	Maricopa
Biomass (lb/ac)	Average	24,141	18,091
	Range	10,812 - 46,268	7,297 - 29,023
Resin (%)	Average	4.6	4.8
	Range	2.9 - 7.4	2.4 - 7.9
Resin (lb/ac)	Average	1,241	868
	Range	526 - 2,566	400 - 1,839
Rubber (%)	Average	2.5	2.5
	Range	1.3 - 3.4	0.8 - 4.0
Rubber (lb/ac)	Average	640	448
	Range	282 - 1,181	150 - 831

> The soil at Eloy is heavier with a higher water holding capacity, allowing for more water available for plant growth, as has been shown in irrigation experiments with increased water applied resulting in higher biomass production (El-Shikha, et al. 2021). However, the heavier soil that is not well drained, can cause problems with root diseases.

> Tremendous diversity was found for all traits evaluated. The range among accessions in biomass production is about 400% at both Eloy and Maricopa, with resin yield and rubber yield at both locations differing among accessions between 400% and 500%.

> For economic traits and components of yield, there is a great deal of genetic diversity found in this germplasm collection.

Any opinions, findings, conclusion or recommendation expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. Grant #: 2017-68005-2686

CONSIDERATIONS FOR PLANTING

- > Bridgestone's first processing facility will be near Casa Grande, AZ
- > Commercial fields will be within 100-mile radius of the processing plant
- > AZ-2, or similar line, will be used in the first commercial fields
- > Bridgestone will supply first commercial lines



PERFORMANCE OF ACCESSION AZ-2

> AZ-2 is the accession that has been used in multiple research projects, and grown on numerous growers' fields. In these trials, for biomass production, AZ-2 yielded just over 22,000 lb/ac at Eloy and 21,000 lb/ac at Maricopa. Resin content for AZ-2 was high at both locations, 7.4% at Eloy and 7.9% at Maricopa. Rubber content was equally high at both locations, 3.1% and 3.4% at Eloy and Maricopa, respectively. Resin yield and rubber yield were very similar at both locations.

Table 3: Performance of AZ-2 at Eloy and Maricopa, AZ

	Biomass (lb/ac)	Resin Content (%)	Resin Yield (lb/ac)	Rubber Content (%)	Rubber Yield (lb/ac)
Eloy	22,298	7	1,611	3	677
Maricopa	21,355	8	1,651	3	715

> Almost all of the guayule germplasm accessions evaluated in these trials are unimproved. A few accessions have been improved for uniformity, like AZ-2. As such, the guayule germplasm accessions evaluated in these trials were compared to AZ-2.

> For biomass, AZ-2 is an average yielder at both locations. This implies that there are many accessions that could be selected to increase biomass yield. However, the economic value of the biomass has not been determined, and the cost of harvest, transportation, storage, and processing would be greater with higher biomass yields.

> Resin content in AZ-2 was the highest of the 45 accessions at both locations, thus the resin yield was also quite high. As products from the resins, such as varnishes, coatings, adhesives, and pesticides/insecticides are developed, AZ-2 will be a valuable resource.

> Rubber yield for AZ-2 is about average at Eloy, but in the top 25% of accessions at Maricopa. At this time, solid rubber for tires is the economic driver for the commercialization of guayule, and there were a number of accessions with high rubber yield that may be used in developing higher yielding lines.

Any opinions, findings, conclusion or recommendation expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. Grant #: 2017-68005-2686

AUTHORS

- > **David Dierig.**
Bridgestone Americas.
DierigDavid@bfusa.com
- > **Von Mark Cruz.**
Bridgestone Americas.
CruzVonmark@bfusa.com
- > **Hussein Abdel-Haleem.**
USDA-ARS. hussein.abdel-
haleem@usda.gov
- > **Blase Evancho.**
UArizona. Tucson, AZ.
bee1@arizona.edu
- > **Sam Wang.** Bridgestone
Americas.
WangSam@bfusa.com
- > **Claire Heinitz.** USDA-
ARS.
Claire.Heinitz@usda.gov
- > **Dennis Ray.** UArizona.
Tucson, AZ.
dtray@arizona.edu



RECOMMENDATIONS FOR COMMERCIALY GROWN GUAYULE VARIETIES

- > The recommendations for guayule varieties to be grown commercially will come from the industry (Bridgestone). They will know which varieties best fit the most important economic products at that time, and which ones have enough seed to plant commercial fields.

REFERENCES

Dierig, D.A.; Thompson, A.E.; Ray, D.T. 1989. Relationships of morphological variables to rubber production in guayule. *Euphytica* 44:259-264.

El-Shikha, D.E.M.; Waller, P.M.; Hunsaker, D.J.; Dierig, D.A.; Wang, G.; Cruz, V.M.; Thorp, K.R.; Katterman, M.E.; Bronson, K.F.; Wall, G.W. 2021. Growth, water use, and crop coefficients of direct-seeded guayule with furrow and subsurface drip irrigation in Arizona. *Ind. Crops Prod.* 170:1113819.

For more information: <https://sbar.arizona.edu>



Any opinions, findings, conclusion or recommendation expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture. Grant #: 2017-68005-2686

Dierig, D.; Cruz, VM.; Abdel-Haleem, H.; Evancho, B.; Wang, S.; Heinitz, C.; Ray, DT. 2021. Comprehensive Evaluation of USDA Guayule Germplasm in Arizona. SBAR Fact Sheet. November.