



SUSTAINABLE BIOECONOMY
FOR ARID REGIONS

IMPACTS OF SOIL MICROBIOME ON GUAYULE RUBBER PRODUCTION

EXECUTIVE SUMMARY

> Guayule (*Parthenium argentatum* G.), a perennial shrub native to the US and Mexico, is under development as an industrial crop in the southwest, as a source of natural rubber, organic resins, and biofuel feedstock. Rubber production rates in guayule are elevated during winter as a stress response to cold temperatures; however, the specific physiological response is poorly understood. Elucidation of environmental factors influencing guayule rubber production is fundamental to enhancing rubber yield in guayule.

> Exploitation of the soil microbiome is an untapped frontier in production agriculture. Soil microbes play critical roles in plant physiology and responses to environmental stress. Plant soil microbe synergies are rarely managed in agriculture production; however, this exciting possibility is being explored in guayule for soil root-zone microbiome interactions. SBAR experiments to date have revealed strong correlations between guayule rubber production and the soil microbial biomass.

SBAR ACCOMPLISHMENTS

> Root-zone microbial community dynamics changed dramatically across guayule growth stages in field trials with distinct soil types.

> Guayule rubber content was positively correlated with soil DNA biomass (total soil microbiome) and negatively correlated with guayule Normalized Difference Vegetation Index (NDVI).

> Relative abundances of 10 bacterial families and 3 fungal classes were positively correlated with plant rubber content.



GUAYULE & THE SOIL MICROBIOME

- > Soil microbiome keystone taxa vary with guayule growth stage
- > Positive correlation: plant rubber content and soil DNA biomass
- > Positive correlation: plant rubber content and specific bacterial and fungal taxa

KEY POINTS OF INTEREST

- > Investigate soil microbiome management
- > Progress to controlled environmental conditions
- > Quantify associations between keystone soil microbes and guayule rubber production

POINT OF CONTACTS

- > **Julie Neilson.** UArizona. Tucson, AZ. jneilson@arizona.edu
- > **Colleen McMahan.** USDA Agricultural Research Service. Albany, CA. colleen.mcmahan@usda.gov
- > **Grisel Ponciano.** USDA Agricultural Research Service. Albany, CA. grisel.ponciano@usda.gov

FUTURE WORK AND POSSIBILITIES

- > The next step is to systematically investigate the impact of growth-stage specific keystone microbes on guayule rubber production.
- > We hypothesize that soil enrichment with the keystone bacteria/ archaeal and/or fungal species that have been identified in association with the winter period will cause significant changes to guayule rubber content.

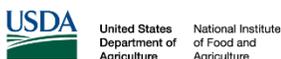


- > Experiments are proposed in controlled greenhouse environments, to systematically vary the relative abundance of specific microbial taxa in the soil microbiome, and to determine microbiome profiles that significantly impact guayule rubber production.

WHAT IS NEEDED

- > Identification of key guayule-soil microbe associations correlated with increased rubber or resin production.
- > Determination of a profile of keystone soil microbes that associate with robust guayule plant establishment.
- > Development of agricultural management practices that enrich for these keystone soil microbes.

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

SBAR Center of Excellence Briefing Paper (Impacts of Soil Microbiome on Guayule Rubber Production). January 2022.