ARPHA Conference Abstracts 6: e109201
doi: 10.3897/aca.6.e109201

Conference Abstract

Acetylenotrophic and Diazotrophic *Bradyrhizobium* sp. Strain I71 from Trichloroethylene-Contaminated Soils

Denise M. Akob[‡], John M. Sutton[§], Timothy J. Bushman[|], Shaun M. Baesman[¶], Edina Klein[#], Yesha Shrestha[‡], Robert Andrews[‡], Janna L. Fierst[¤], Max Kolton[«], Sara Gushgari-Doyle[»], Ronald S. Oremland[¶], John L. Freeman[˄]

‡ U.S. Geological Survey, Reston, Virginia, United States of America
§ AbSci, Vancouver, Washington, United States of America
| The University of Alabama, Tuscaloosa, Alabama, United States of America
¶ U.S. Geological Survey, Menlo Park, California, United States of America
# Karlsruhe Institute of Technology, Karlsruhe, Germany
¤ Florida International University, Miami, Florida, United States of America
« Ben-Gurion University of the Negev, Beer Sheva, Israel
» University of California, Berkeley, California, United States of America
˄ Intrinsyx Environmental, Mountain View, California, United States of America

Corresponding author: Denise M. Akob (dakob@usgs.gov)

Received: 08 Jul 2023 | Published: 17 Oct 2023

Citation: Akob DM, Sutton JM, Bushman TJ, Baesman SM, Klein E, Shrestha Y, Andrews R, Fierst JL, Kolton M, Gushgari-Doyle S, Oremland RS, Freeman JL (2023) Acetylenotrophic and Diazotrophic *Bradyrhizobium* sp. Strain I71 from Trichloroethylene-Contaminated Soils. ARPHA Conference Abstracts 6: e109201. https://doi.org/10.3897/aca.6.e109201

Abstract

Acetylene (C_2H_2) is a trace constituent of Earth's modern atmosphere and is used by acetylenotrophic microorganisms as their sole carbon and energy source (Akob et al. 2018) Acetylenotrophs hydrate acetylene through a reaction catalyzed by acetylene hydratase, which is a heterogeneous class of enzymes. As of 2018, there were 15 known strains of acetylenotrophs including aerobic species affiliated with the Actinobacteria, and Firmicutes and anaerobic species affiliated with the Desulfobacterota. However, we hypothesized that there was an unknown diversity of acetylenotrophs in nature. We recently expanded the known distribution of acetylenotrophs via the isolation of the aerobic acetylenotroph, *Bradyrhizobium* sp. strain I71, from trichloroethylene (TCE)-contaminated soils (Akob et al. 2022). Strain I71 is a member of the class Alphaproteobacteria, and this is the first

observation of an aerobic acetylenotroph in the Proteobacteria phylum. The isolate grows via heterotrophic and acetylenotrophic metabolism, and is diazotrophic, capable of nitrogen fixation. Acetylenotrophy and nitrogen fixation are the only two enzymatic reactions known to transform acetylene, and this is only the second isolate known to carry out both reactions (Akob et al. 2017, Baesman et al. 2019). Members of *Bradyrhizobium* are well studied for their abilities to improve plant health and increase crop yields by providing bioavailable nitrogen. The unique capability of *Bradyrhizobium* sp. strain I71 to utilize acetylene may increase the genus' economic impact beyond agriculture as acetylenotrophy is closely linked to bioremediation of chlorinated contaminants (Mao et al. 2017, Gushgari-Doyle et al. 2021). Based on genome, cultivation, and protein prediction analysis, the ability to consume acetylene is likely not widespread within the genus *Bradyrhizobium*. These findings suggest that the suite of phenotypic capabilities of strain I71 may be unique and make it a good candidate for further study in several research avenues such as contaminant biodegradation and nutrient cycling.

Keywords

microbial ecology, contaminants, environmental health, acetylene, nitrogen fixation, chlorinated solvents

Presenting author

Denise M. Akob

Presented at

ISEB-ISSM 2023, Poster presentation. Suggested themes: Part 1: Natural Settings; Part 3: Astrobiology and Earth Analog Settings; Part 4: Emerging Tools & Areas of Scientific Inquiry

Funding program

U.S. Geological Survey, Environmental Health Program (Toxic Substances Hydrology and Contaminant Biology)

Conflicts of interest

The authors have declared that no competing interests exist.

References

- Akob D, Baesman S, Sutton J, Fierst J, Mumford A, Shrestha Y, Poret-Peterson A, Bennett S, Dunlap D, Haase K, Oremland R (2017) Detection of Diazotrophy in the Acetylene-Fermenting Anaerobe *Pelobacter* sp. Strain SFB93. Applied and Environmental Microbiology 83 (17): e01198-17. https://doi.org/10.1128/aem.01198-17
- Akob D, Sutton J, Bushman T, Baesman S, Klein E, Shrestha Y, Andrews R, Fierst J, Kolton M, Gushgari-Doyle S, Oremland R, Freeman J (2022) Acetylenotrophic and Diazotrophic *Bradyrhizobium* sp. Strain I71 from TCE-Contaminated Soils. Applied and Environmental Microbiology 88 (22): e0121922. https://doi.org/10.1128/aem.01219-22
- Akob DM, Sutton JM, Fierst JL, Haase KB, Baesman S, Luther GW, Miller LG, Oremland RS (2018) Acetylenotrophy: A Hidden but Ubiquitous Microbial Metabolism? FEMS Microbiology Ecology 94 (8): fiy103. https://doi.org/10.1093/femsec/fiy103
- Baesman S, Sutton J, Fierst J, Akob D, Oremland R (2019) *Syntrophotalea acetylenivorans* sp. nov., a diazotrophic, acetylenotrophic anaerobe isolated from intertidal sediments. International Journal of Systematic and Evolutionary Microbiology 71 (3): 004698. https://doi.org/10.1099/ijsem.0.004698
- Gushgari-Doyle S, Oremland R, Keren R, Baesman S, Akob D, Banfield J, Alvarez-Cohen L (2021) Acetylene-Fueled Trichloroethene Reductive Dechlorination in a Groundwater Enrichment Culture. mBio 12 (1): e02724-20. https://doi.org/10.1128/mbio.02724-20
- Mao X, Oremland R, Liu T, Gushgari S, Landers A, Baesman S, Alvarez-Cohen L (2017) Acetylene Fuels TCE Reductive Dechlorination by Defined *Dehalococcoides*/*Pelobacter* Consortia. Environmental Science & Technology 51 (4): 2366-2372. https://doi.org/10.1021/acs.est.6b05770