Soil microbes: Prairie restoration tool

Researchers from Western Michigan University (WMU) are investigating ways to improve soil microbial communities (SMCs) in reclaimed agricultural land, which could help mitigate climate change.

Tallgrass prairies, a disappearing ecosystem, have been established in agricultural fields in recent years as conservation corridors as land managers seek to reduce soil erosion, reintroduce native plant diversity and provide habitats for native pollinators. Yet the SMCs in these restored prairies do not resemble those in remnant North American prairies.

"We'd like land managers to able to restore prairies completely because the soil's bacterial community has the potential to increase the amount of carbon that can be stored in the soil and reduce greenhouse gas emissions," says Zach Whitacre, a WMU graduate student who is leading the project. "In addition to greater carbon storage, shifting the soil's bacterial communities could accelerate the establishment of late-successional plants, such as nodding wild onion and rattlesnake master."

Previous research indicates that cellulose microcrystalline, a recalcitrant carbon source, can be added to the soil to improve the bacterial community. Yet cellulose microcrystalline is not a practical solution, due to the amount needed and its high cost. Whitacre's idea is to use biomass instead. "Cellulose is found in the cell walls of most plants, so the application of plant material could produce the same results at a relatively low cost," he explains.

Working with researchers at the University of Minnesota and land managers at the Edward Lowe Foundation and the Washington Conservation District, Whitacre began a field experiment in April 2019. Two prairie restorations sites were selected: one in Michigan at Big Rock Valley (BRV), the foundation's headquarters, and the other in a reclaimed ag field in Afton, Minnesota. The sites were selected due to their different soil textures. BRV has silty, clay-based soil while the Minnesota site has sandy soil.

A member of Kathryn Docherty's research lab at WMU, Zach Whitacre is trying to enhance bacterial communities in prairie restorations — work that may have implications for mitigating climate change.

At each site, Whitacre's team established 18 plots of tallgrass prairie — six were inoculated with cellulose microcrystalline, six with little bluestem biomass and six as the control group. One objective was to see if the cellulose microcrystalline would produce the same microbial shift in the field as it did in a previous greenhouse study. Another key goal was to compare the plots with the bluestem biomass to see if it produced a similar, or even better, shift.

Preliminary testing in August 2019 showed the bluestem biomass in the Minnesota plots was, indeed, altering the soil community to microbes better at storing carbon — and bluestem was doing a better job than the cellulose microcrystalline. "No change was seen at BRV, which could be a result of soil type or environmental factors," Whitacre says, noting that Southwest Michigan experienced a drought last summer while Minnesota did not. "Microbes need water to better access nutrients in the soil, so that could have been part of the reason."

Whitacre will resample the soil later this summer. He also plans to measure the plant biomass to see if it has increased. "We think the bacterial community could shift at the BRV site but will take longer," he says. "One of our findings may be that prairie restorations need to be tailored differently from one state to another due to environmental factors."

Whitacre's project is novel in that most prairie research focuses on aboveground methods rather than the underground bacterial community. "It can take years to fully establish a prairie corridor if you're just relying on native plant seeding alone," Whitacre says. "Yet if successful, restoring microbial diversity would enhance the establishment of native prairie plants while also improving carbon storage and reducing greenhouse gas emissions."