Researcher says cyanobacteria could help manage nitrogen to benefit Chesapeake Bay

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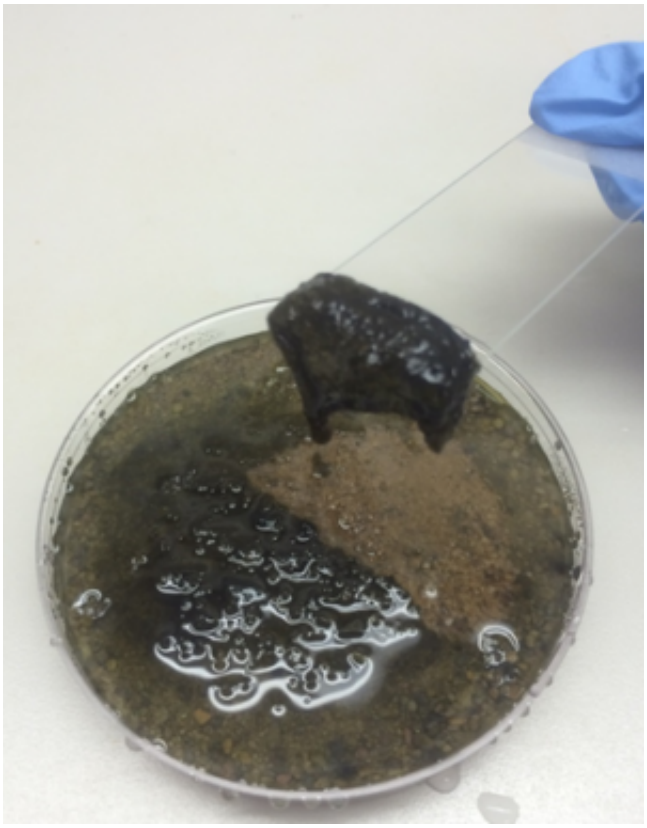

Cyanobacteria, are unique in their ability to absorb and immobilize excess nitrogen in soils that are too rich and also to "fix" or add carbon and nitrogen from the air to soils that are depleted. Credit: Penn State

A novel approach to harness bacteria that could diminish nutrient-laden runoff from agriculture has the potential to support efforts to restore the

Chesapeake Bay, where water quality improvements have been elusive, research suggests.

The organisms, called cyanobacteria, are unique in their ability to absorb and immobilize excess nitrogen in soils that are too rich and also to "fix" or add carbon and nitrogen from the air to soils that are depleted, according to Mary Ann Bruns, associate professor of ecosystem science and management in Penn State's College of Agricultural Sciences.

Cyanobacteria occur naturally at times in some soils. If they can be cultivated and more widely introduced, they could substitute for some of the fertilizer now being applied by farmers, Bruns explained.

Colonies of cyanobacteria create a bluish-green biofilm over soil, most often in the fall after crops are harvested. Bruns became aware of their existence when she noticed a colony a decade or so ago at the Penn State Agronomy Research Farm at Rock Springs. Now, after several years of research, she estimates that their nitrogen-fixing abilities could substitute for up to 25 pounds per acre of manufactured nitrogen fertilizer.

"But best of all, cyanobacteria and their associated mosses and algae can take up excess nitrogen, keep it from being lost through runoff or leaching, and release it more slowly during the growing season. These biofilms also serve to make the soil surface more cohesive and resistant to erosion, and they will not fix nitrogen from the air if there already is nitrogen in the soil," Bruns said.

"Cyanobacteria are a potential tool to increase nitrogen-use efficiency, not just in the Chesapeake basin, but globally. Only 50 percent—and just 40 percent in some countries—of nitrogen is used by crops, so there is an awful lot of nitrogen getting into aquifers and waterways. If we could improve this situation with biological organisms that don't require any energy inputs or purchases, it would be huge."

Researchers have been experimenting with methods of growing cyanobacteria colonies in photobioreactors on a large scale with the goal of licensing the technology to an agricultural company. Credit: Penn State

Supported by a Research Applications for Innovation—or RAIN—Grant from the College of Agricultural Sciences, Bruns and a graduate student in ecology, Xin Peng, have been experimenting with methods of growing cyanobacteria colonies on a large scale with the goal of licensing the technology to an agricultural company.

The objective of the project is to develop cyanobacterial cultures as commercial soil amendments—or biofertilizers—and renewable nitrogen sources for landscaping, agriculture and land reclamation. Bruns and Peng have isolated cyanobacteria from soils at the Penn State Agronomy Research Farm and then have grown sufficient quantities in photobioreactors for greenhouse experiments.

In the first year of the project, they demonstrated that cyanobacterial biomass applied to soil surfaces increased fivefold to tenfold within 40 days and could regrow after being on dried-out soils for two months and longer. Ironically, it's the ability of cyanobacteria to regrow annually that may make them unattractive to the agricultural companies that might consider cultivating and selling the organisms in large quantities to farmers in either a powdered or liquid form.

"There are farmers who are interested in trying this in Pennsylvania, but we don't have the means to grow a lot of the material," she said. "If it's not a product that farmers will need to buy annually, you can see how it might be a less lucrative proposition for the private sector to invest in and produce. But I hope we can interest a company in producing cyanobacteria biofertilizer because I think, widely used, it could improve the quality of our waters."

Provided by Pennsylvania State University

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