

New test measures corn nitrogen needs with greater accuracy

March 10 2020, by Fred Love



Mriganka De, a postdoctoral research associate in agronomy, lowers a stream-water sampling bucket off of a bridge to determine field runoff levels. More accurate field testing could help farmers better gauge the nitrogen levels in their fields, allowing them to make more efficient use of fertilizer. Credit: Stephen Potter.

The soil fertility tests farmers have used for decades to measure nitrogen levels don't account for the vast majority of the nitrogen in soils, so Iowa State University scientists helped develop a new test that yields more accurate results by using soil biology.

Marshall McDaniel, an assistant professor of agronomy, recently led a study published in the peer-reviewed *Agronomy Journal* that analyzed a combination of [soil](#) tests to gauge corn nitrogen needs more accurately than standard [chemical](#) tests. Nitrogen plays an essential role in [plant growth](#), and farmers need to know how much nitrogen is present in their soil to optimize their application of nitrogen fertilizer. McDaniel said the study, completed in collaboration with other universities, could lead to more accurate fertilizer nitrogen recommendations, resulting in economic benefits to farmers and improved environmental quality.

McDaniel said farmers have relied on chemical extraction tests for roughly 50 years. Most of these tests measure only immediately plant-available forms of nitrogen such as nitrate and ammonium. But those tests don't account for the majority of nitrogen stocks stored in soil organic matter. This form of nitrogen requires soil microorganisms, which McDaniel referred to as nitrogen "gatekeepers," to release the plant nutrient from soil organic matter to become available to corn.

To address that, McDaniel and his colleagues used 30 biological and chemical soil tests to find the best [test](#), or combination of tests, to predict nitrogen needs of corn crops across 56 experimental field sites from the late 1990s. The researchers then applied a machine-learning algorithm capable of finding the best combination of tests to predict optimal nitrogen fertilizer application for corn. The best combination of tests included a chemical test that measured nitrogen trapped in clay, and a biological test that measured nitrogen released by soil microbes in a 14-day incubation at optimal temperatures and moisture to cause the microbes to release nitrogen from soil organic matter.

They also compared the results from their combination of chemical and biological tests with those of the standard chemical tests. They found their combination testing method reduced overapplication and underapplication of nitrogen fertilizer by about 40%. That's important because farmers want to make the most efficient use of their fertilizer as possible. Overapplying nitrogen can result in excessive runoff and other environmental impacts, while underapplication can lower crop yields.

Typically, farmers take soil samples in the spring or soon after their crops emerge and send them to a laboratory that conducts the chemical test. McDaniel said biological tests, such as the one incorporated in his experiments, have grown in popularity over the last few decades. But he said the 14-day incubation period required for the [biological test](#) carried out in his lab probably will prevent the method from being used more broadly. Private laboratories conducting soil tests for farmers have to turn their results around faster than two weeks, he said. Now McDaniel's research group is working on shorter biological tests that would more likely be adopted by laboratories. But he predicted that labs will begin to combine multiple tests, especially using biological tests like the one they used, to get more accurate corn [nitrogen](#) recommendations.

"I don't think this exact process will be adopted broadly, but the

[combination](#) of using machine learning with biological and chemical tests shows great promise for the future," he said.

More information: M. D. McDaniel et al. Combination of biological and chemical soil tests best predict maize nitrogen response, *Agronomy Journal* (2020). [DOI: 10.1002/agj2.20129](https://doi.org/10.1002/agj2.20129)

Provided by Iowa State University

Citation: New test measures corn nitrogen needs with greater accuracy (2020, March 10)
retrieved 27 April 2024 from <https://phys.org/news/2020-03-corn-nitrogen-greater-accuracy.html>

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