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Breakthrough research demonstrates "how Gene-Edited microbes offer a new source of Nitrogen to farmers"Â

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Peer-reviewed research published inÂ *Scientific Reports*Â describes a new technology that could revolutionize a century-old approach to providing nitrogen to crops. The study, a collaboration of researchers from theÂ University of Wisconsin-Madison,Â Purdue University, andÂ Pivot Bio, a leading sustainable agriculture company, presented first-of-its-kind evidence showing how gene-editing enhances microbes' ability to fix atmospheric nitrogen and transfer it to cereal crops.

Using **isotopically labeled nitrogen**, researchers traced nitrogen in the air to chlorophyll of corn leaves, providing evidence that it was fixed from the air by the gene-edited microbes. Field studies also showed that these microbes could fix and supply nitrogen comparable to up to 40 pounds of synthetic nitrogen fertilizer per acre with similar yields.

Improving the effectiveness of nitrogen fertilizers has been a long-standing challenge. "The core issue," explains Dr.Â Bruno Basso, a professor of environmental science atÂ Michigan State University, who was not involved in the study, "is that the soil-plant-atmosphere system is extremely complex." Unpredictable weather makes it difficult to match nutrient supply to plants' demand, and to determine precisely how much nitrogen a crop will require and whether the nutrient will remain in the soil. The on-fields research strives to devise solutions to use nitrogen fertilizer more efficiently to increase profit and reduce environmental impact, such as nutrient losses to groundwater and greenhouse gas emissions to the atmosphere.

Diazotrophs, special types of bacteria that occur in nature, have a unique ability to turn atmospheric nitrogen gas into ammonium, the building block of amino acids and proteins. This process, commonly known as biological nitrogen fixation (BNF), was the main form of nitrogen nutrition for crops for thousands of years before synthetic nitrogen fertilizer was invented.

Researchers at Pivot Bio developed gene-edited microbes using non-transgenic methods to enable diazotrophs to continue providing nitrogen to the crop even under high nitrogen conditions. "With the gene edits, we blind microbes to the presence of nitrogen in their surroundings, so they continue to fix ammonium, delivering it directly on the root system,"Â said Dr.Â Karsten Temme, chief innovation officer and co-founder at Pivot Bio and a co-author of the paper.Â "We also introduced other edits to ensure the bacteria can transfer the fixed nitrogen to the crop instead of keeping it for itself."

The paper presents evidence of this process happening in the lab and field test plots. It is also the first peer-reviewed paper covering PROVEN$^{Â®}$ 40, Pivot Bio's second-generation commercial product for corn containing gene-edited nitrogen-fixing microbes.

In the field, the researchers used a variety of isotopic experiments to again demonstrate nitrogen fixation, this time under real-world conditions, and quantify the nitrogen levels in the plant. They also collected hundreds of samples from farmers who reduced nitrogen fertilizer rate by 35 to 40 pounds of nitrogen per acre, replacing it with Pivot Bio's PROVEN 40. On average, researchers found plants treated with PROVEN 40 had *higher nitrogen levels* early in the season and no negative impacts on yield, even though they had received less synthetic fertilizer.