# Belgian researchers provide a strong boost to sustainable agriculture

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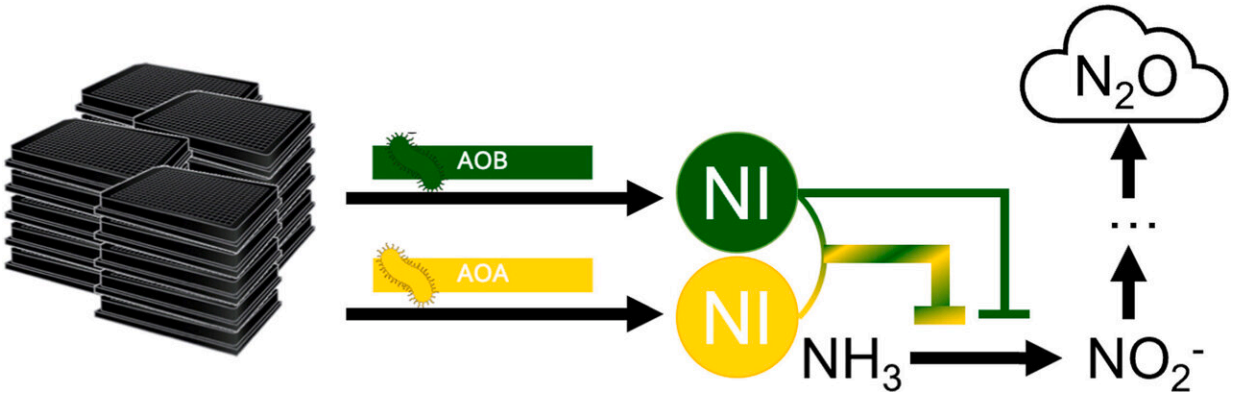


Credit: *Journal of Environmental Management* (2023). DOI: 10.1016/j.jenvman.2023.118996

Much has been written about the European Climate law and the European Nitrate Directive. Besides social concerns, drastically reducing greenhouse gases by 2030 and structurally lowering the use of nitrogen in agriculture poses significant challenges. Researchers from the VIB-UGent Center for Plant Systems Biology now present concrete research results to lower nitrogen usage by targeting microorganisms in the soil.

Their findings have been published in the journals *Frontiers in Plant Science*, *Trends in Microbiology* and the *Journal of Environmental Management*.

## Nitrogen and the soil microbiome

Plants need nitrogen in the soil to grow. However, these plants compete with certain bacteria and archaea, two types of microorganisms that are also able to use nitrogen in the soil. These microorganisms convert nitrogen—in the form of ammonia—into nitrites and nitrates through a process called nitrification.

These nitrites and nitrates leach into the soil, groundwater, and recreational water, making them unusable for agricultural crops and negatively impacting biodiversity and water quality. Additionally, nitrates can be converted into the potent greenhouse gas nitrous oxide or laughing gas. Farmers often fertilize excessively to ensure their crops have enough nitrogen, with negative consequences for biodiversity and the environment.

## Stopping nitrification

Finding substances that block nitrification by microorganisms (known as nitrification inhibitors) is the key to a more efficient use of nitrogen in agriculture. When these microscopic soil organisms consume less nitrogen, more is available for plants, reducing the need for fertilization. Previous research focused strongly on soil bacteria, neglecting archaea. Researchers from the VIB-UGent Center for Plant Systems Biology now shed light on these mysterious microorganisms, completing the picture.

"The importance of these archaea for nitrogen consumption in the soil was long ignored. Current commercial inhibitors against bacteria are not only limited, they are also ineffective against archaea. To increase the efficiency of nitrification inhibition, we looked for nitrification inhibitors against archaea," says Dr. Fabian Beeckman, postdoctoral researcher at the Beeckman lab (VIB-UGent).

The research group developed two test methods to identify nitrification inhibitors in archaea and examined nearly 50,000 molecules for their functional use.

"Not only have we described nitrification inhibitors for archaea, but we have also shown that a combination of inhibitors against bacteria and archaea yields the best results," says Dr. Hans Motte, project coordinator. "This result is very promising. We now have the tools to find and combine the best inhibitors, truly reducing nitrogen usage in agriculture."

## A sustainable future

Efficient nitrogen management is a goal that falls under the European climate law and European Nitrate Directive. In this context, the researchers go a step further towards sustainability.

"Currently, all nitrification inhibitors are synthetic molecules," says Professor Tom Beeckman, group leader of the Beeckman lab. "With our new test methods, we can now search for natural molecules that can also serve as nitrification inhibitors. In the next step, we can even look at plants that produce and excrete these products themselves in the soil. This opens the door to more efficient organic farming and sustainable agricultural systems."

**More information:** Fabian Beeckman et al, High-throughput assays to identify archaea-targeting nitrification inhibitors, *Frontiers in Plant Science* (2024). DOI: 10.3389/fpls.2023.1283047

Fabian Beeckman et al, Enhancing agroecosystem nitrogen management: microbial insights for improved nitrification inhibition, *Trends in Microbiology* (2023). DOI: 10.1016/j.tim.2023.10.009

Fabian Beeckman et al, Drug discovery-based approach identifies new nitrification inhibitors, *Journal of Environmental Management* (2023). DOI: 10.1016/j.jenvman.2023.118996