

BNI trait could improve nitrogen-efficiency of crops

A new report describes certain plants that possess a trait known as biological nitrification inhibition (BNI). The trait allows the plants to suppress the loss of nitrogen (N) from the soil and improve the efficiency of its uptake and use by themselves and other plants.



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The authors, who form part of a new BNI research consortium, propose transferring the BNI trait from those plants to critical food and feed crops, such as wheat, sorghum and Brachiaria range grasses, in order to boost crop productivity and reduce greenhouse gas emissions.

“Nearly a fifth of the world’s fertiliser, for example, is deployed each year to grow wheat and the crop only uses about 30% of the nitrogen applied,” according to Guntur Subbarao, a researcher with Japan’s International Research Center for Agricultural Sciences (JIRCAS) and lead author of the study.

“If BNI research is successful, it would turn wheat, the world’s most widely grown food crop, into a super nitrogen-efficient crop,” he said. “Farmers would spend far less on fertiliser and nitrous oxide emissions from wheat farming could be reduced by as much as 30%.”

Major source of emissions

Excluding changes in land use such as deforestation, annual greenhouse gas emissions from agriculture each year are equivalent to as much as 5.8-billion tons of carbon dioxide (CO₂), or 11% of the total emissions from human activity (Smith et al. 2014).

Nitrogen fertilisers are a major source of agricultural emissions. About 70% of nitrogen applied to crops in fertilisers is either washed away or flushed into the air as nitrous oxide (N₂O), a greenhouse gas 300 times more potent than CO₂.

“The most widely grown crop on the planet, wheat is a major nitrogen user and N₂O emitter,” said Hans Braun, director of the global wheat program at the International Maize and Wheat Improvement Center (CIMMYT). “BNI technology is one of several options we’re pursuing to reduce nitrogen losses from wheat farming, but more funding is needed.”

BNI Brachiaria to feed cattle

The *Plant Science* study also mentions high-BNI forage crops, such as certain tropical Brachiaria grasses that produce brachialactone, a powerful BNI chemical.

The grasses can be eaten by cattle, while reducing N₂O emissions and improving soil fertility for other crops grown in rotation on the same land, according to Michael Peters, leader of the tropical forages programme at the International Center for Tropical Agriculture (CIAT).

“It may be counter-intuitive to many, but growing BNI Brachiaria to feed cattle can actually help reduce greenhouse gas emissions from livestock production,” Peters said, adding that unlocking BNI capacity in other crops would help reduce nitrogen fertiliser use across the board, benefiting farmers and the environment at large.

Work on BNI-enabled sorghum is also under way at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

Difficult and costly

But scientists at CIMMYT and ICRISAT say that BNI-enabled food crops will be a few years in coming, because it is difficult and costly to transfer the genetically complex BNI trait into elite crop varieties while preserving high yield potential and other desirable qualities.

Subbarao and others are calling for major research investments to have high BNI food and forage crops grown widely across the globe by 2050 and thus help to meet the goal of limiting global temperature increases to 2 degrees Celsius above pre-industrial levels.

“Dramatically reducing nitrous oxide emissions from agriculture requires a complex, integrated approach that includes more precisely calculating and applying fertiliser doses,” Subbarao said. “But the beauty of BNI technology is that it works with and reinforces biological processes, and all you’ll need to do is sow a seed.”

According to Masa Iwanaga, the president of JIRCAS, BNI technology typifies the transformation needed in the current agricultural model and practices, to meet 21st century food production challenges.

“Feeding a global population projected to exceed 9-billion by 2050 will place a tremendous strain on agri-food systems and the environment,” Iwanaga said. “At the same time, agriculture is not merely a commodity-producing industry, but part of a larger ecosystem that offers life support and services to human society.”