Available online at www.sciencedirect.com

ScienceDirect

Procedia Environmental Sciences 29 (2015) 303

Procedia Environmental Sciences

Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Impacts of agricultural nitrogen on the environment and strategies to reduce these impacts

Michael Udvardi[a], Eoin L. Brodie[b] and William Riley[b], Shawn Kaeppler[c], and Jonathan Lynch[d],

[a]*Samuel Roberts Noble Foundation, Ardmore 73401, USA;* [b]*Lawrence Berkeley National Laboratory, USA;*
[c]*University of Wisconsin, USA;* [d]*Penn State University, USA*

Abstract

Nitrogen is a primary limitation to plant productivity, a major energy and economic input in agroecosystems, and a primary source of environmental pollution via gaseous and leaching losses. The success of the Green Revolution was largely due to breeding of superior plant varieties and the massive use of fertilizers, especially synthetic N-fertilizers, to fulfil the higher yield potential of the new varieties. Today, agriculture uses over 100 million metric tons of fertilizer-N each year, which has doubled the flux of N through the terrestrial N-cycle. Production of fertilizer-N, via the Haber-Bosch process, consumes an enormous amount of fossil fuel, and produces a matching amount of CO2. Likewise, distribution and mechanical application of fertilizer to fields consume fossil fuels and add to atmospheric CO2. About a half of the fertilizer-N applied to fields is captured and used by the target crop, while the rest is lost to the environment. A small percentage is converted to the potent greenhouse gas, N2O, which contributes substantially to the total greenhouse gas emissions from agriculture. Current high-input agricultural systems are not sustainable, in part because they rely on finite fossil fuels and in part because of their negative effects on environmental systems.

Several approaches are being taken to reduce the use and environmental impacts of fertilizer-N, while maintaining or even increasing plant productivity, including greater use of symbiotic nitrogen fixation in legumes, use and improvement of associative nitrogen fixation in non-legumes, and the development of synthetic nitrogen-fixing systems for key crop species. Plant breeding approaches to improve nitrogen use efficiency in crop species and management strategies to reduce nitrogen losses from fields are also underway and have met with some success. Basic research is still required to fully understand nitrogen dynamics in the complex and varied agroecosystems, which are affected by interactions between plants, soil, microbes, climate and other environmental variables. Understanding nitrogen dynamics and transformations in agroecosystems will help us to manage better the nitrogen resources in these systems, which will increase agricultural sustainability and reduce its impact on the environment and climate.

Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)

Keywords: Nitrogen use efficiency; nitrogen fixation; agroecosystems; sustainability.

Peer-review under responsibility of the organizing committee of the Agriculture and Climate Change - Adapting Crops to Increased Uncertainty (AGRI 2015)
doi:10.1016/j.proenv.2015.07.275