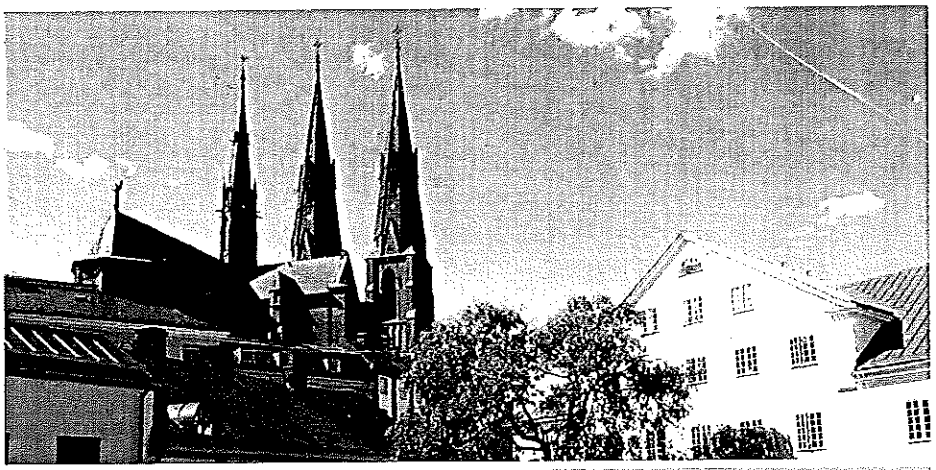
Summer drought and fertilizer applications affect densities of denitrifying bacteria in a pasture soil

Sven Marhan, Adrian Hartmann, Laurent Philippot, Ellen Kandeler, Pascal A. Niklaus

Bageco10

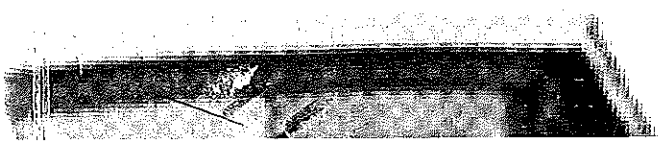




BAGECO 10

Bacterial Genetics and Ecology – Coexisting on a Changing Planet

15–19 June 2009 • Uppsala • Sweden

Program & Abstract



SLU
Swedish University of Agricultural Sciences

UPPSALA UNIVERSITET

Uppsala Microbiomics Center

We thank all our sponsors for their contribution!

Gold sponsors

The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning

Swedish University of Agricultural Sciences

Silver sponsors

Exhibitors

Local Organizing Committee

Professor *Janet Jansson*
Department of Microbiology, Swedish University of Agricultural Sciences, Uppsala, Sweden (janet.jansson@mikrob.slu.se)
Senior Staff Scientist, Lawrence Berkeley National Laboratory, Berkeley, CA, USA (jrjansson@lbl.gov)

Stefan Bertilsson, Uppsala University
Susanne Broqvist, SLU
Sara Hallin, SLU

Conference Secretariat

Academic Conferences
SLU & Uppsala University in cooperation
Tel: +46 18 67 20 84
e-mail: bageco@slu.se

P159

SUMMER DROUGHT AND FERTILIZER APPLICATIONS AFFECT DENSITIES OF DENITRIFYING BACTERIA IN A PASTURE SOIL

Sven Marhan[1], Adrian Hartmann[2], Laurent Philippot[3], Ellen Kandeler[1] and Pascal A. Niklaus[2]

[1]Institute of Soil Science and Land Evaluation, Soil Biology Section, University of Hohenheim, Emil-Wolff-Str. 27, Stuttgart, Germany, 70599

[2]Institute of Plant Sciences, ETH Zurich, LFW C55.2, Universitaetstrasse 2, Zurich, Switzerland, 8092

[3]INRA-University of Burgundy, Laboratory of Soil Microbiology and Geochemistry, Dijon Cedex, France, 21065

An important part of the land area in the altitude regions of central Europe is formed by pastures. Pastures often receive high amounts of nitrogen fertilizers, which are known to increase the emission of nitrous oxide (N_2O) immediately after application. Most of the N_2O emitted from soil is expected to derive from the denitrification process when soil moisture is high and sufficient substrate (nitrate) and easily available carbon sources (DOC) are present. Under a changing climate, expected alterations in temporal patterns of rainfall and a postulated reduction of precipitation during summer will influence soil moisture as well as plant performance and therefore microbial activity in soils. This probably affects also the denitrifier community in soil which is responsible for a substantial part of N_2O production as well as for N_2O consumption (further reduction of N_2O to N_2). The aim of the present study was to investigate the effects of summer drought (reduction of precipitation) and different fertilizer types (mineral N, sheep urine and farmyard manure, FYM) on N_2O emissions and densities of soil denitrifying bacteria of a pasture in the Swiss Alps. The experimental plots were fertilized with 300 kg N ha^{-1} a^{-1}. Half of the plots were covered with roofs to reduce precipitation during the summer 2007 and 2008. Annual precipitation (2007: 1800 mm) was reduced by this treatment by ~25%. N_2O production rates were measured weekly and daily after fertilization. Soil temperature and moisture were monitored in the field. Densities of total bacteria and denitrifiers were monitored before and three weeks after each fertilization in 2007 and 2008 by quantifying the 16S rRNA and the *narG*, *napA*, *nirK*, *nirS* and *nosZ* denitrification genes by real-time PCR.

The N_2O emission was strongly reduced by the drought treatment, whereas FYM and especially urine fertilization increased N_2O efflux from soil in the no-roof controls plots. First results from Sept. 2007 showed that the densities of total bacteria and denitrifiers were significantly reduced by drought. In contrast, inorganic-N fertilization slightly increased the density of total bacteria while both the density of total bacteria and denitrifiers was stimulated by organic N-fertilizers. The results of the present experiment indicate that denitrifying bacteria in soil can be heavily affected by drought and fertilization, leading to modified potentials of pasture soils for greenhouse gas emissions.