Nitrous Oxide Emission from Nitrogen Saturated Forest

Junko Ikutani[1]; Keisuke Koba[2]; Muneoki Yoh[3]

[1] Graduate school of Tokyo Univ. Agri. Tech.; [2] Tokyo University Agric Tech; [3] Tokyo Univ. Agri. Tech.

Nitrogen deposition into the forest ecosystems is recently increased by human activities. Although forests are generally nitrogen limited, it is reported that some forests are nitrogen saturated by the increase of such nitrogen deposition[1)]. Increasing in the nitrogen deposition can affect the production and consumption of nitrous oxide (N_2O), which is one of the greenhouse gases and is produced by nitrification and denitrification in soils. However, how the increase of nitrogen deposition affects N_2O production by nitrification and denitrification is not clear. So, the purpose of this study is to examine the processes of N_2O production in nitrogen saturated forest's soil.

Study site was the Field Museum Tama (FM Tama) of the Tokyo University of Agriculture and Technology, Hachioji, Tokyo. The FM Tama had been reported as the nitrogen saturated forest[2)]. Soil samples were collected from 0-15cm depth. The soil was brown forest soil. Soils were sieved (2mm) and its moisture content was adjusted to 60% of water-holding capacity. Samples were placed in 300ml glass bottles, and a rubber stopper with sampling ports was placed each bottle. Acetylene (C_2H_2) was injected into bottles so that the headspace partial pressure is 10kPa, 10Pa, or no C_2H_2. The bottles were incubated in the dark for 10 days at 25 degrees Celsius. Headspace was sampled every two or four days to measure N_2O concentrations by GC-ECD. The difference between N_2O production rates with the three treatments (10kPa, 10Pa and control) can be used to calculate the N_2O produced by nitrification, denitrification and N_2O reduction[3)].

The difference between N_2O concentration of control and that under 10Pa treatment was not stastically significant and N_2O concentration of 10kPa treatment was statistically higher than other treatments. The production rate of N_2O was largest under 10kPa, and control samples showed the smallest rates (236.4 and 2.8[micromol N_2O/kg fresh soil/h], respectively). Production of N_2O was calculated as follows; nitrification N_2O: -52.1micromol N_2O/kg fresh soil/h, denitrification N_2O: 54.9micromol N_2O/kg fresh soil/h, denitrification N_2: 181.5micromol N_2O/kg fresh soil/h. N_2O production rate by nitrification was calculated as negative rate, but the difference between N_2O concentration of control and that of 10Pa treatment was not statistically significant, and we treated this minus value as zero. Therefore, it was suggested that N_2O was not emitted by nitrification and N_2O was mainly emitted by denitrification. Moreover, there was significant production of N_2 by denitrification exceeded total N_2O production. Thus, it was concluded that the processes of N_2O emission were mainly dominated by the reduction of N_2O by denitrification at the study site, though the soils were in aerobic condition.

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