PB 101

Efects of carbon, nitrogen and pH on methane oxidation in soils of urban and remote forests

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Increasing concentration of atmospheric CH_4 is of concern as it contributes to global warming. Although CH_4 uptake in forest soil has been considered as a major sink of the greenhouse gas in many countries, little study has been made for Korean forest soil. To figure out the capacity of CH_4 oxidation in forest soils, CH_4 oxidation rates were compared over four months in urban (Mt. Nam) and remote forests (Mt. Jumbong) with a static chamber method. Based on the field data, laboratory experiments were conducted to determine the factors influencing the activity of methane oxidation. Effects of glucose, nitrogen and soil pH were examined by soil incubation experiments of 3^3 factorial design. A similar seasonal variation of CH_4 consumption was observed in Nam and Jumbong forests, highest in August and lowest in October. The rate was significantly lower in Nam soil than in Jumbong soil during August-October, 1997. Rates of CH_4 consumption ranged from 1.13 to 1.98 mg m^{-2} day^{-1} in Nam soil and from 2.03 to 2.50 mg m^{-2} day^{-1} in Jumbong soil. According to the field experiment, it was hypothesized that the oxidation rates of CH_4 in the soils were associated with soil acidity, organic matter degradation and nitrogen availability caused by air pollution. In laboratory experiment as well, CH_4 oxidation was higher in Jumbong soil than in Nam soil. Soil acidity was an important factor in determining the rate of uptake of CH_4. Methane oxidation decreased with increasing acidity. Methane oxidation was significantly enhanced by glucose addition in Nam soils, but not in Jumbong soils, suggesting that it was limited by little availability of organic carbon in the urban soil. Addition of ammonium chloride significantly decreased CH_4 oxidation rates in both soils, but inhibitory effect was not so much great in Nam soil as in Jumbong soil. It might be associated to the differences of nitrogen availability and biomass of methanotrophs between Jumbong and Nam soils. There were significant interactions of acidity, glucose and ammonium with respect to CH_4 oxidation. Methane oxidation was negatively correlated with amounts of ammonium-N and nitrate-N added to Jumbong soils, but not to Nam soils. Methane oxidation was positively correlated with soil respiration rate in Jumbong soil, but not in Nam soil. Only pH showed strong relationship with CH_4 oxidation in Nam soil.