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Nutrient loading enhances methane flux in an ombrotrophic bog

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Peatlands are significant sources of atmospheric methane (CH_4) and emission rates may be affected by atmospheric nutrient inputs and associated changes in vegetation. In a long-term (10-15 yr) fertilization experiment at a nutrient-poor, *Sphagnum* moss- and dwarf shrub-dominated bog in eastern Canada, we tested the effect of ammonium nitrate (NH_4NO_3,0 to 6.4 g N m^{-2} yr^{-1}) and potassium phosphate (KH_2PO_4,5 g P m^{-2} yr^{-1}) on fluxes of CH_4. Fluxes were measured using a closed chamber technique over the growing seasons of 2005 and 2015. The effect of long-term field treatments on aerobic consumption and anaerobic production potentials of CH_4 was tested by laboratory incubations of peat samples, as well as an amendment with KH_2PO_4on anaerobic production potentials at the water table. Over the 10-15 yr, three levels of N plus PK addition and N-only addition of 6.4g N $m^{-2}yr^{-1}$ decreased the abundance of *Sphagnum* and *Polytrichum* mosses, increased the growth and coverage of dwarf shrubs, and caused a decline in surface elevation and thus a higher water table. Overall, CH_4 flux was small, $\sim$ 12 mg m^{-2} d^{-1} in the control plots, primarily because of the low water table (30 to 50 cm beneath the peat surface), but flux varied as a function of water table position and treatment. KH_2PO_4 addition was associated with the highest fluxes: in the 5^{th} treatment year, the PK treatment had the largest CH_4 flux ($\sim$25 mg m^{-2} d^{-1}), whereas in the 15^{th} year the 6.4NPK treatment had the largest flux ($\sim$50 mg m^{-2} d^{-1}). Rates of potential production and consumption of CH_4in laboratory incubations of peat samples were associated with position relative to the water table. Anaerobic potential CH_4production was largest in the PK treatment and overall was marginally increased by PK amendment; there were no clear effects of NH_4NO_3 on CH_4 production. The major increase in CH_4 flux appearing in the long term seemed to be result of the change in water table position owing to peat subsidence and loss of moss, plus potential stimulation of CH_4 production by PK.