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Studies on the Impact of Biological Fertilizers on Methane Emission from Rice Paddy Microcosms

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Abstract

Methane is a trace gas in the Earth's atmosphere. It came into the focus of public and scientific interest because of its expected contribution to global climatic changes (green house effect). Although it is a relatively minor component of the global carbon cycle, it is of great importance because its relative capacity for infrared absorption is greater than that of CO_2. The major sources of CH_4 are rice paddy fields, natural wetlands, enteric fermentation, biomass burning, termites and gas drilling. Methane emission is the outcome of the balance between methane production, oxidation and transport. Emissions from rice paddies indicate a global source of 60 $Tg.yr^{-1}$ with a range between 20-100 Tg yr^{-1}. Besides affecting the climate, methane plays an important role in both troposphere and stratospheric chemistry. Thus, in an effort to reduce uncertainties, the research work was carried out to study the impacts of biofertilizers of methane emission using rice microcosms (IR50 cultivar type) inoculated with Azolla and Asospirillum amendments. The Control microcosms were without any amendments.

Azolla (symbiotic) and Asospirillum (asymbiotic) organisms, fix large amount of atmospheric N_2. The soil used for microcosm study was Alfisol soil type with predominant sandy nature. The soil pH ranged between 6.8 and 7.4 providing optimal conditions for menthanogenesis. The total organic carbon in the soil is observed as 0.74%. The amount of available nitrogen was observed as 78 mg kg^{-1} dry weight of soil. The average methane flux from Control rice microcosms increased from 22.9 mg m^{-2} d^{-1} at the time of transplantation to 80.2 mg m^{-2} d^{-1} during reproductive stages and finally declined to 38.4 mg m^{-2} d^{-1} at the harvesting stage of the crop. The mean seasonal average integrated methane flux and its range was found to be 3.8±1.5 g m^{-2}. In Azolla amended microcosms average

methane flux increased from 21.8 mg m^{-2} d^{-1} during transplantation to 128.01 mg m^{-2} d^{-1} at reproductive stages and finally declined to 48.53 mg m^{-2} d^{-1} during harvesting stage of the crop. The mean seasonal average integrated methane flux and its range was found to be 4.97±2.7 g m^{-2}. The highest average fluxes correspond to 65^{th} day after transplantation. Azolla application shows some important effects on chemical soil properties, which could affect CH_4 emission by decrease in dissolve O_2 concentration of the overlying water, increase NH_4^+-N content of the soil, depress water-soluble organic carbon, Eh, and porosity of the soil. In Asospirillum amended microcosms average methane flux increased from 20.08 mg m^{-2} d^{-1} during transplantation to 76.01 mg m^{-2} d^{-1} at reproductive stages and finally declined to 34.1 mg m^{-2} d^{-1} during harvesting stage of the crop. The mean seasonal average integrated methane flux and its range was found to be 3.2±1.3 g m^{-2}. The highest average fluxes correspond to 65^{th} day after transplantation. The inoculation of rice roots with *Asospirillum spp.* may result in decrease in methane emission due to stimulation of root growth and root hairs by the production of phytohormone, 3-5 fold increase in the permeability of the root cell wall causing an enhanced oxidation of the rhizosphere. Thus in conclusion Azolla amendment has enhanced methane fluxes by 35%, while Asospirillum amendment resulted in the decline of methane emissions by 8.65% in comparison with Control microcosms.

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Biogeochemical Cycle of Methane in a Coastal Lagoon: Pulicat Lake, South India

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Abstract

Concern about the steadily increasing atmospheric CH_4 concentration from terrestrial and aquatic environments has stimulated research to quantify their sources and sinks. Tropical natural wetlands in recent times have been of great environmental concern due to human intervention such as urbanization, intensification of agriculture etc. The present study focuses on the biogeochemical pathways of methane and its cycling from a coastal lagoon (Pulicat Lake) in South India. The first aspect of the study deals with the various processes of methane formation including the methanogenic stimulation by competitive and non-competitive substrates, sequential reduction of electron acceptors (SO_4, Fe) and the effect of methanogenic inhibitors on CH_4 production. The second aspect of the work deals with CH_4 production along the profile and *in vitro* CH_4 production by algae/sea grass and sediment slurries. The third aspect of the research work provides an insight into the phenomenon of CH_4 oxidation (*in vitro*) in the algae/sea grass and sediment upper layers (0-2 and 2-4 cm). The fourth aspect deals with the spatial variation of CH_4 in the surface water (dissolved form) and sediments (soil pore water) from the entire lake. Also the temporal variations of CH_4 fluxes (i) chamber fluxes from the sediment-water interface; and (ii) bubble ebullition and (iii) sediment core fluxes from the boundary layer have also been studied. Pulicat Lake contributes only a minor source of CH_4 to the atmosphere. Increases in the concentration of CH_4 can be expected in the future if there is a continuation of the current rate of human change due to intensified human mediated disturbances.

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Seasonal Dynamics of Nitrous Oxide and Methane Emission from Muthupet Mangroves

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Abstract

N_2O and CH_4 are relatively long lived trace gases which strongly influence earth's climate and the chemical budget of the atmosphere. Atmospheric inventories of N_2O and CH_4 are increasing by ~25% yr^{-1} and ~0.3% yr^{-1} and together they account for ~18% of enhanced green house forcing. Natural wetlands are one of the major sources for N_2O and CH_4 emissions to the atmosphere. This study deals with the seasonal and temporal fluctuation of N_2O and CH_4 in the Muthupet mangroves, Tiruvarur District, Tamil Nadu. Fluxes of CH_4 and N_2O were measured using closed chamber technique from the sediment water interface during four different seasons of a year. Results revealed that the average annual emission of N_2O was about 8.19mg m^{-2} d^{-1} and CH_4 was about 16.07 mg m^{-2} d^{-1}. It was observed that the N_2O efflux was maximum during monsoon season, followed by post monsoon and summer and least in the premonsoon. CH_4 efflux was maximum during summer season followed by premonsoon and monsoon and least in the post monsoon. It was also noticed that the N_2O and CH_4 emission from Muthupet mangroves is modulated by the number of pneumatophores, physico-chemical factors and also the anthropogenic influence such as aquaculture and agricultural inputs.

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