Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 24 (2016) 196 – 202

Procedia Technology

International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015)

# Effect of Controlled-Release Nitrogen Fertilizer on Methane Emission from Paddy Field Soil

Anitha K[a*], Bindu G[b]

[a] *Department of Civil Engineering, Government Engineering College, Thrissur, Kerala, Pin-680009, India*
[b] *Associate professor, Department of Civil Engineering, Government Engineering College, Thrissur, Kerala, Pin-680009 ,India*

**Abstract**

An experimental study was conducted to investigate the effect of Controlled Release Nitrogen Fertilizer on $CH_4$ emission from a rice paddy field soil using pot experimental setup. The experiment is designed with three fertilizer types, i.e., controlled-release nitrogen fertilizer (Neem oil coated urea) and urea (U) and organic fertilizers like Gliricidia sepium, cowpea, Farmyard manure etc. There are two rice cultivars Uma and Jyothy were used for the pot experiment. Each experiment replicate triply. Methane flux was measured at different growth stages for the two rice cultivar by one-time application of CRNF compared with Urea and Organic fertilizer. The methane emission was noted at different rice growth stages. Finally the total $CH_4$ emission from the cultivar is also calculated. $CH_4$ emission was decreased at vegetative stage, gradually increased at reproductive stage and decreased at grain filling to maturity. Methane emission was higher from Heading to flowering, accounting for 35.21% to 41.53% of total cumulative emission. CRNF significantly affect the biometric characters like tiller number, plant height, biomass, and yield in rice by using CRNF. Rice yields increased by 11.43 and 11.11 % for Uma and Jyothy rice respectively.


Peer-review under responsibility of the organizing committee of ICETEST – 2015

*Keywords:* Controlled-release nitrogen fertilizer; Uma and Jyothy rice; pot experiment; Methane Flux; Paddy field soil;

## 1. Introduction

Global warming becomes one of the tremendous challenges for human being. It is mainly caused by increased atmospheric concentrations of the greenhouse gases. Methane (CH4) is the most abundant organic trace gas in atmosphere. That plays important roles in atmospheric chemistry and in the earth´s energy balance [1].

* Corresponding author. Tel.: +0 949 763 28 13; fax: +0 949 763 28 14.
*E-mail address:*anithasubashk@gmail.com


Peer-review under responsibility of the organizing committee of ICETEST – 2015
doi:10.1016/j.protcy.2016.05.027

The Inter-governmental Panel on Climate Change's (IPCC), 2007 [2] points out that the warming potential of methane is 25 times than that of carbon dioxide (100 years time scale). Out of the anthropogenic sources third place goes to the paddy field. Rice is one of the main food crops in India. Effects of inorganic nitrogen fertilizer on $CH_4$ emission from rice paddies were complicated, which were controlled by soil Carbon, Nitrogen (C/N) ratio, fertilizer type, amount, utilization pattern, etc [3]. Controlled- release nitrogen fertilizer (CRNF), so called eco-friendly fertilizer, delayed nitrogen (N) releases to the soil, provided a better N supply for plant uptake [4]. Some experiments illustrated that controlled-release fertilizer reduced N losses through decreasing nitrous oxide emission, ammonia volatilization, and runoff, compared with ammonium sulfate or urea (U). New technologies employing controlled-release fertilizer (CRF) can be used as effective mitigation alternatives to control environmental fertilization impacts [5]. The amount of nitrate present in soil is the major factor influencing its concentration in plants is more than the original source of nitrogen. The increase in nitrogen emission from soil is adversely affects the ecology, caused for atmospheric changes due to the greenhouse gases. It also increased biological productivity and lowered the bio-diversity through the fertilization effects resulting from ammonia deposition in forests and waters. CRNF provided the proper supply of nitrogen to the soil and reduced the production of methane. Methane is produced in paddy soil by the reduction of hydrogen and carbondioxide by methanogens under anaerobic conditions. Some of this methane can be oxidized by methanotrophs and the remaining can be entered the atmosphere [6].

There are three pathways to emit methane from rice paddies to the atmosphere these are diffusion, ebullition and plant mediated transport. Ebullition is only about 10 % of the total emission. The emission from diffusion is only less than 1 %. The rice plant itself introduced the remaining 90 % through the plant's sheath, leaf blades, Culm and roots [7]. According to the IPCC, 1996 [8] the amount of emission of $CH_4$ from rice paddies are the functions of the soil type and temperature, rice species, irrigation practices, duration and number of the harvest, and fertilizer use. The possible carbon sources of $CH_4$ emitted from rice paddies are rice plants (roots), soil organic matter, and organic matter applied to the paddies as nutrients [9]. In India, the most important ways to lowering the emission of methane from rice paddies are the right selection of rice cultivars, improved water management, and fertilizer usage [10]. A few reports are available about the effect of controlled release Nitrogen fertilizer on $CH_4$ emission in rice paddies. Two common rice varieties are selected here to study the effect of CRNF supply on methane emission compared with Urea as Nitrogen fertilizer.

## 2. Materials and methods

### *2.1 Soil Preparation*

The laterite soil samples were collected from an upland site at the Kundannur, Kundannur Village, Thalapilly Taluk, Thrissur District, Kerala state with a latitude: $10^o$ 38' 43'' and longitude: $76^o$ 16' 20". Soil was collected from the plough layer at a depth of 0–15 cm. The soil was analyzed for their basic characteristics. Soil pH was determined in the laboratory by a glass electrode method with a soil water solution at a ratio of 1:2 (w/v). Soil Organic Carbon was measured by oxidizing with $K_2Cr_2O_7$ and concentrated $H_2SO_4$. Total N was measured as 4mg/Kg. The collected soil was dried at sun light for a period of one month.

### *2.2 Experimental Design*

A pot experiment was conducted at the premises open terrace of residential building,Velur which is located nearer to the Government Veterinary Hospital, Velur, Thrissur district, India. The experiment was arranged with randomized complete block design. In this experiment, the two rice cultivars selected were Uma and Jyothy. The N fertilizers such as Controlled-Release Nitrogen Fertilizer (CRNF), Urea (U) and the Organic manure and P and K fertilizers as factomphos and potash are taken as nutrients. Six set of treatments are conducted by using three different N fertilizers (CRNF, Urea and Organic manures) and two types of rice cultivars (Uma and Jyothy) each of with three triplicates shown in the figure 1. The experimental setup covered approximately 6.7% area of the open terrace. Rice seeds were sowed on 17$^{th}$ January, 2015 in a basin.

The solar dried soil was filled upto 20cm of pots having size (D×H=25 cm×30 cm). Three seedlings were transplanted into each of the 18 pots on 16$^{th}$ February, 2015. Fertilizer is applied as conventionally with two stages