IMPACT OF WATER AND FERTILIZER MANAGEMENT ON METHANE EMISSION FROM RICE FIELDS

M.P.C.P.Kumara[1], S.P.Nissanka[1], G.Seneviratne[2] and D.N.Sirisena[3]

[1]*Department of Crop Science, Faculty of Agriculture, University of Peradeniya*
[2]*Institute of Fundamental Studies, Hantana, Kandy*
[3]*Rice Research and Development Institute, Batalagoda, Ibbagamuwa*

Introduction

CH_4 is the second most important greenhouse gas (GHG) and it contributes about 20% of the predicted global warming. Rice farming is considered as the major source of atmospheric CH_4 (IPCC, 2007). The flooding of rice fields initiates a series of events involving anaerobic degradation of organic substrates leading to the production of CH_4. Emission of CH_4 from rice fields depends on the soil conditions such as soil temperature, pH, Eh and organic C% etc (Minamikawa and Sakai, 2005). It may also change with fertilizer and water management, rice varieties and growth stages of rice. Methane emissions have not been studied in detail under local conditions. Therefore, this study was initiated with the objective of assessing CH_4 emission from rice fields managed with different water regimes and fertilizer levels.

Materials and Methodology

The experiment was conducted at the Rice Research and Development Institute, Batalagoda, Sri Lanka during June to September 2010. The experiment was a two factor factorial regime with two levels (intermittent and saturated), and (2) fertilizer with two levels (Inorganic and inorganic with compost (5 t/ha)). Fertilizer was used as recommended by the Department of Agriculture. Plot size was 1.5 m x 2 m. Seventeen days old seedlings of variety Bg 352 were transplanted at spacing 15 cm x 15cm. Initial soil nutrient status (N, P, K, Organic Carbon %, Soil pH, EC, CEC, and Eh) was measured. Gas was collected for methane analysis by placing an air tight chamber (60 cm x 60 cm x 70 cm), in the morning (09.00-09.30 am), afternoon (12.00-12.30 pm) and evening (15.00-15.30 pm) from each plot at weekly intervals. Temperature of soil, ambient air, and air inside the chamber were also measured at every sampling. Collected gas into vacutainer tubes (20 ml) was analyzed using Gas Chromatography at the laboratory of the Institute of Fundamental Studies. CH_4 flux was calculated according to the methodology reported by Rolston, 1986.

Results and Discussion

Methane emission was greatly vary with the stage of development of rice plant (<0.05) (Fig. 1, 2 and 3). There was no significant influence of water

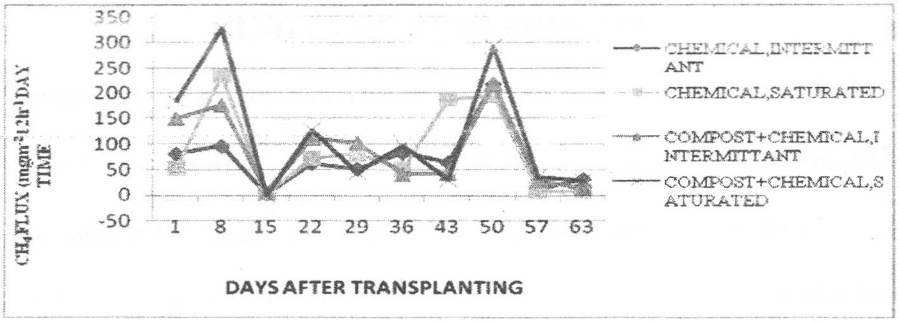

Fig. 1 Variation of CH_4 emission with interaction effect at different days after transplanting the rice crop ($P<0.05$)

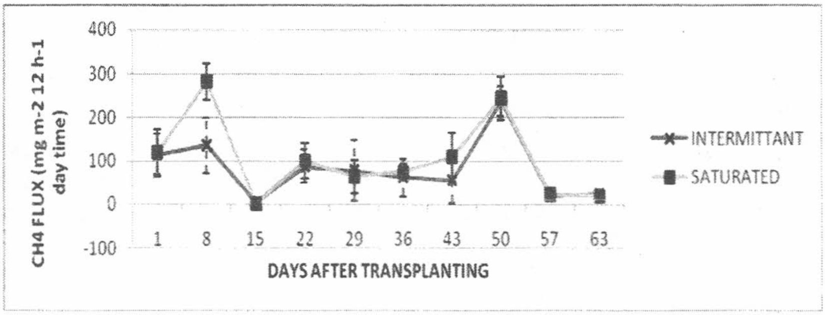

Fig. 2 Variation of CH_4 emission with water regime at different days after transplanting the rice crop ($P<0.05$)

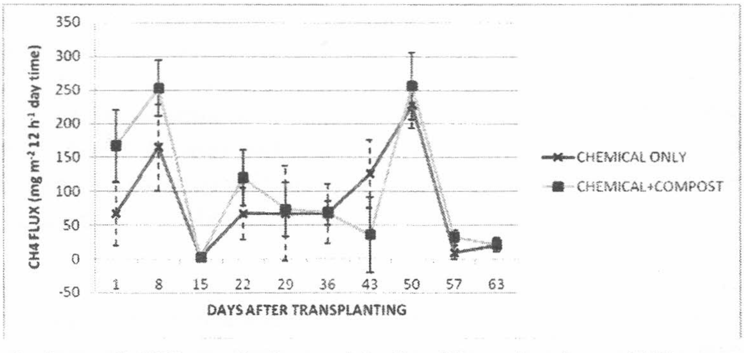

Fig. 3 Variation of CH_4 emission with fertilizer level at different days after transplanting the rice crop ($P<0.05$)

regimes and fertilizer levels on CH_4 flux. The first peak of CH_4 flux was observed at the early vegetative stage, which was due to high decomposition rate of incorporated compost, previous crop stubbles and higher initial soil organic 'C' content (1.3%). Second peak was observed at the maximum tillering stage (50 days after transplanting). Increase in tiller number which enhances the secreation of root exuadates and decomposition rate of root hair materials (increase in soil 'C') and also expansion of CH_4 emitting passage through plants, resulted in the highest recorded CH_4 emission at the peak tillering period (255 mgm^{-2}12hr day time). Emissions rates were drastically reduced during reproductive stages (92.24 mg m^{-2} for 12hr day time) as less substrates were available for methanogenesis bacteria due to enhanced sink demand for photosynthates by the developing grains.

There was a tendency to have slightly lower emission rates in the treatments where intermittent irrigation was practiced and organic matter was not added (Figs 1 and 2). However, saturated conditions lead to create more aneorobic conditions, hence high methanogenesis activity (Bharati *et al.*, 2001). Average CH_4 emission with intermittant water supply was 81.4 mgm^{-2} 12hr day time compared to that of saturated conditions of 103.1 mgm^{-2}12hr day time. CH_4 emission from the compost applied treatment in combination with inorganic fertilizer resulted in higher CH_4 flux compared to the inorganic fertilizer alone. Compost provides easily decomposable substrate for methanogenesis. Average CH_4 emission with inorganic fertilizer alone was 82 mgm^{-2}12hr day time, while with chemical and compost was 102.5 mgm^{-2}12hr day time. When diurnal fluctuation is considered, higher flux was observed during noon to 2.00 pm. Lower emission was recorded in the morning and evening.

Conclusion

Methane emission rates vary with the growth stages of rice plant. The highest emissions were recorded at the peak tillering stage. Saturated with inorganic and compost treatment tend to release higher rate of CH_4. Intermitted irrigation slightly reduced methane emission. Seasonal average of CH_4 emission flux express in 12 hr day time across all treatments was 92.2 mg^{-2} 12hr^{-1}.

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