International Journal of Science, Environment and Technology, Vol. 5, No 4, 2016, 2308 – 2314

ISSN 2278-3687 (O)
2277-663X (P)

ORGANIC VS CONVENTIONAL FARMING: A COMPARATIVE STUDY ON METHANE EMISSION

Annie Abraham*[1], Rita Kumar[1] and Nirmal Kumar[2]

[1]Department of Biol. & Environmental Science, Natubhai V. Patel College of Pure and Applied Science, Vallabh Vidyanagar – 388120, Gujarat, India

[2]P.G Department of Environmental Science and Technology, Institute of Science and Technology for Advanced Studies and Research (ISTAR) Vallabh Vidyanagar – 388120, Gujarat, India

E-mail: bincykizhakkodan@gmail.com (**Corresponding Author*)

Abstract: Methane emission monitoring was carried out using close static chamber method from Wheat agriculture farm for the period of 21days. Two study sites following Conventional type of farming and Organic type of farming were selected. Methane flux from conventional farming ranged from 0.016 mg/m^2/hr to 0.66 mg/m^2/hr and in Organic farm ranged from 0.018 mg/m^2/hr to 0.744. The comparison of mean value obtained per day showed less methane emission from Organic farm.

Keywords: Methane emission, Wheat agriculture, Conventional farming, Organic farming.

Introduction

The agriculture sector including crop production and livestock farming contributes majorly for Green House Gas (GHG) emission. Farms emitted 6 billion tonnes of GHG in the year 2011 that is 13 % of global GHG emission. GHG emission is strongly influenced by land use and especially the crop cultivated in the soil [1].

Although agriculture is a major sector responsible for climate change, the sector itself observes the detrimental effects. The effect like increase in salinity of soil, soil erosion and soil desertification, pest and plant diseases are seen [10].

Several practices have been followed in the field to manage soil fertility, such as crop management practices like management of fertilizers and tillage practices, maintaining the quality of the soil by rotational grazing and altering forage composition etc. The paradigm shift of organic farming from conventional farming has brought a revolution in the agriculture sector

The choice of food depends on individual. To become healthy and to remain healthier for a longer period of time people have started using Organic Products. However the emission taking place from the Organic farming brings a question on this production system.

*Received July 7, 2016 * Published Aug 2, 2016 * www.ijset.net*

Seeing the benefits of Organic farming more and more farmers are motivated to go for Organic farming so to confirm with all the benefits people are getting from organic farming whether it reduces the CH_4 emission from agriculture soil the author has taken the work of comparing CH_4 emission from conventional farming and Organic farming.

Materials & Methods

Study area:

Site1: Khodiyar farm

The study area Khodiyar farm is located between 22º 34' 27.55 85" N latitude and 72 º 56' 27.9812" E longitude which is 5 km away from head quarter. The total area of the agricultural field is approximately 9728.06 sq. m. The temperature of the area remains around 28°C. This area receives annual rainfall during the months of July to September. This agriculture farm follows conventional type of farming using chemical fertilizers and pesticides.

Site2: Bhaikaka Organic Farm

Bhaikaka Organic Farm is located at Tarapur village (22º 32'42.5214 N, 72º 50'19.9846E) which falls under Anand district, Gujarat. The total area of Bhaikaka Organic Farm (BOF) is 7 ha. This study site is 10km far from the head station. The average temperature prevailing here is 32ºc. The area also receives annual rain during the months of July to September. This study area has granular and cores soil. The topography of the area is flat. Organic type of farming practice is followed in this area with the use of animal manure and biocides.

Methane emission sampling

Methane emission sampling was carried out simultaneously from both the farms for the wheat growing season, beginning from second week of January to 1st week of February on weekly basis. The sampling was carried out using close static chamber method [3]. The closed chamber was designed with nonreactive plastic material. A small fan was fixed for equal distribution of the gases in close chamber. A small area fixed with rubber cork was utilised as a sampling vent. Thermometer was also fixed to record the temperature inside the close chamber.

Sampling was carried out during the time period 3pm to 5pm from both the sites. The instrument was fixed inside the soil one hour before starting the sampling. Samples were collected at every half an hour interval using 20 ml disposable syringe, equipped with a three way stop cork. The samples were drawn into syringe and transferred into pre evacuated glass vials. The glass vials were preserved into an ice box until brought to the laboratory. They

were further stored in refrigerator until taken for gas chromatography analysis. Methane gas was analysed using Perkin Elmer auto system gas chromatograph equipped Flame Ionisation Detector (F.I.D) at Sophisticated Instrumentation Centre for Applied Research and Testing (SICART) Vallabh Vidyanagar, The value obtained for gas concentration by gas chromatography was used to calculate methane flux using following formula

$$F=\rho \frac{V}{A}\frac{P}{P0}\frac{T0}{T}\frac{dCt}{dt}$$

Source: (Nirmal kumar et al., 2012) [5]

Where,

F is CH_4, CO_2, and N_2O gas flux (mg /m^2/hr)

ρ is gas density at the test temperature (mg/m^3)

V is chamber volume available (m^3)

A is bottom area of the chamber (m^2)

P is atmospheric pressure in the field (h Pa)

P_0 is atmospheric pressure under standard condition (h Pa)

T_0 is absolute air temperature under standard conditions (25ºC)

T is absolute air temperature in chamber at the time of sampling (ºC)

C is concentration of mixed volume ratio of gases in chamber at time t (10^{-6}).

Results & Discussion

Methane emission monitoring was carried out using close static chamber method from both the farms following conventional type of farming and Organic farming. In Khodiyar farm the lowest value observed for methane emission was 0.016 mg/m^2/hr and the maximum value observed was 0.66 mg/m^2/hr (fig 1).The mean values obtained were minimum of 0.154 mg/m^2/day and maximum of 0.375 mg/m^2/day. The decreasing trend of methane emission was observed throughout the study period which showed maximum emission in the second week of sampling, that is 7th day and a decreasing trend was followed till 21st day of sampling. Maximum emission was observed on 7th day at 5pm, however except 7th day higher methane flux was observed at 3.30 pm.

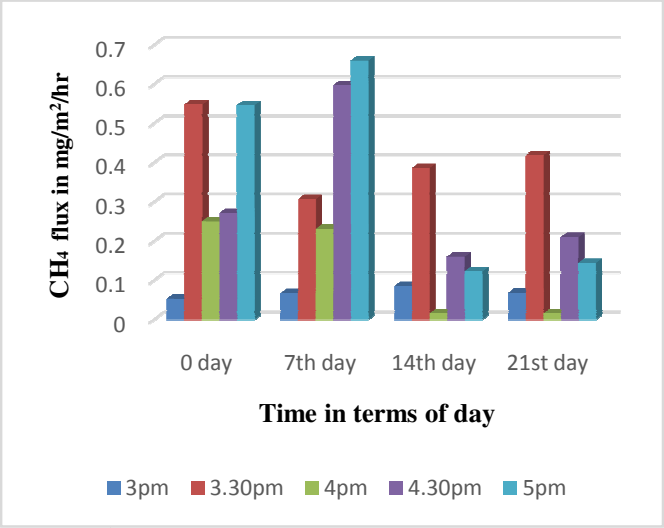

Fig 1 Temporal variation of methane at study site 1.

In Bhaikaka Organic farm the lowest methane emission observed was 0.018 mg/m^2/hr and the maximum emission observed was 0.744 mg/m^2/hr. The mean values obtained were minimum of 0.1094 mg/m^2/day and maximum of 0.257 mg/m^2/day. The highest methane flux was observed on 7th day of sampling at 3.30 pm (Fig 2)

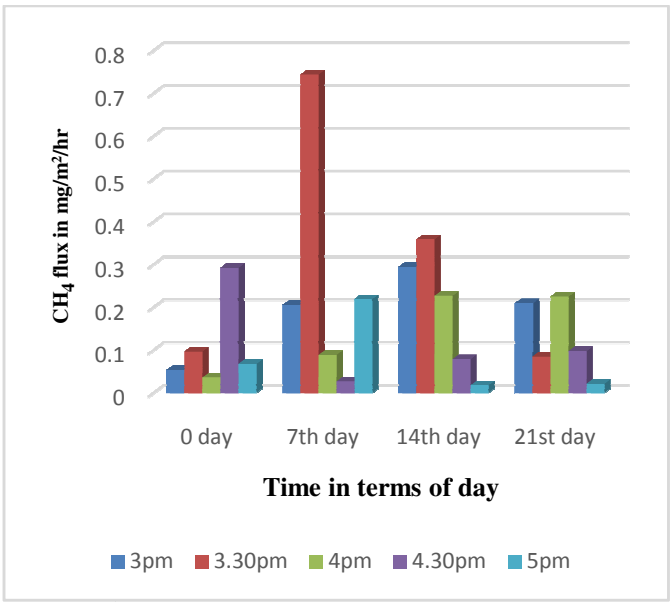

Fig 2 Temporal variation of methane at study site 2

The comparison between weekly emissions of CH_4 from Khodiyar farm and Bhaikaka Organic farm also showed a decreasing trend of Methane emission. Highest methane emission was observed at 2nd week of sampling from both the study sites.(Fig3) The results matches with the result obtained by Schutz et al 1989[9]; and Nirmal Kumar et al 2009[6]

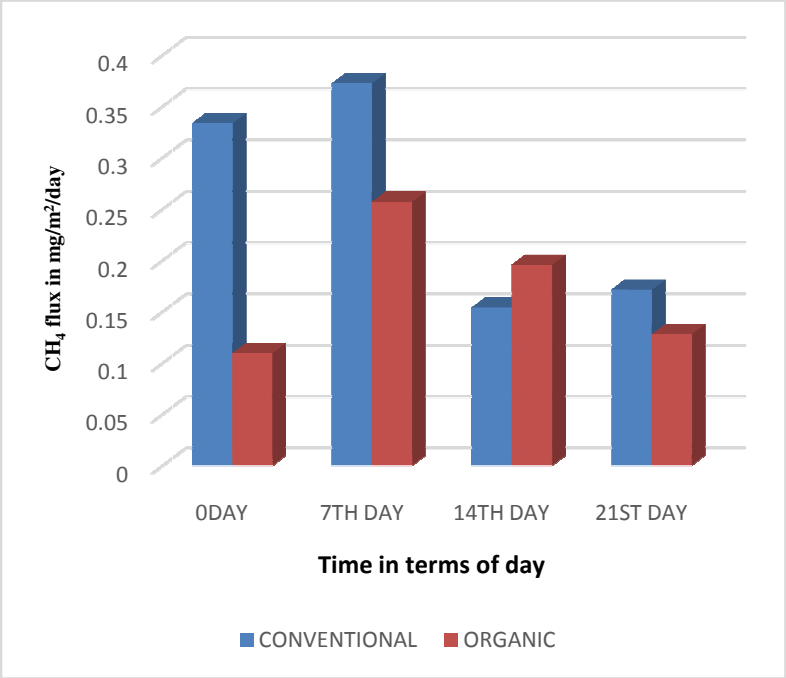

Fig 3 comparison between CH_4 emission from Conventional farming and Organic farming

The result of single factor ANOVA confirmed that the values obtained for methane flux mg/m^2/day for both the farms differed significantly (P> 0.05). The climatic factors and edaphic factors were also studied during the time of sampling.

The experiment of comparison between CH_4 emission from conventional farming and Organic farming gave less Methane flux value for organically managed farm that is Bhaikaka Organic farm. Other than the manure management the irrigation pattern followed in both the farms was also different. The Khodiyar farm followed full irrigation pattern in which the soil was inundated with water completely, while in Bhaikaka Organic farm the irrigation pattern used was drip irrigation pattern which moistened the soil less compared to the Khodiyar farm soil. Husin et al [4] and Yagi et al [11] in their work have confirmed that CH_4 emission is more in flooded soil than in poorly irrigated soil.

A lot of work has been carried out previously to see the difference of G.H.G emission from conventional and organic farming from dairy farms. The research carried out to know energy use and GHG emission shows less energy use and GHG emission from crop production. There is always a less GHG emission on per area bases, where as there is an equal amount of GHG emission when compared on a unit product basis [8],[2].

Küstermann & Hülsbergen found less GHG emission that is CO_2eq ha^{-1} a^{-1} from Organic farming than in Conventional farming which can be corroborated with this work [7].

Conclusion

- This study concludes that Organic type of practice followed in Wheat farm gives less emission of methane compared to conventional type of farming
- Methane emission depends on many climatic factors and soil parameters which may differ the emission.
- It needs a long term research to confirm less methane emission taking place from Organic farming.

Acknowledgement

The authors are thankful to UGC New Delhi – MANF for financial assistance. We are also thankful to Sophisticated Instrumentation Centre for Advanced Research and Testing (SICART), V.V. Nagar, Gujarat for sample analysis.

References

[1] Ball, B., Scott, A., Mc Taggart, I.P., & Watson, C.A. (2002). Greenhouse gas emissions from soils under organic management. In Proceedings of the UK Organic Research 2002 Conference (pp. 243-246). Organic Centre Wales, Institute of Rural Studies, University of Wales Aberystwyth.

[2] Bos, J.F., de Haan, J., Sukkel, W., & Schils, R.L. (2014). Energy use and greenhouse gas emissions in organic and conventional farming systems in the Netherlands. NJAS-Wageningen Journal of Life Sciences, 68, 61-70.

[3] Collier, S.M., Ruark, M.D., Oates, L.G., Jokela, W.E., & Dell, C.J. (2014). Measurement of greenhouse gas flux from agricultural soils using static chambers. JoVE (Journal of Visualized Experiments), (90), e52110-e52110.

[4] Husin, Y.A., D. Murdiyarso, M.A.K. Khaill, R.A. Rasmussen, M.J. Shearer, S. Sabiham, A. Sunar and H. Adijuwana Methane flux from Indonesian wetland rice: The effects of water management and rice variety. Chemosphere, 31, 3153-3180 (1995).

[5] Kumar, J.I., Patel, K., Kumar, R.N., & Gupta, P. (2012). Assessment of soil-atmosphere exchange of greenhouse gases and their environmental factors in tropical dry deciduous forest and eucalyptus plantation at central Gujarat, Western India. International Journal of Environmental Sciences,2(4), 1873-1888.

[6] Kumar, J.N., & Viyol, S.V. (2009). Short-term diurnal and temporal measurement of methane emission in relation to organic carbon, phosphate and sulphate content of two rice fields of central Gujarat, India. Paddy and Water Environment, 7(1), 11-16.

[7] Küstermann, B., & Hülsbergen, K.J. (2008). Emission of Climate-Relevant Gases in Organic and Conventional Cropping Systems.

[8] Olesen, J.E. (2009). Organic farming and the challenges of climate change.Ecology and Farming 44, 2-5.

[9] Schutz, H., A. Holzaptel-Pschorn, R. Conrad, H. Rennenberg and WSeiler (1989): A three-year continuous record on the influence of day time season and fertilizer treatment on methane emission rates from an Italian rice paddy. J. Geophysics Resour, 94, 16405-16416.

[10] Scialabba, N., & Hattam, C. (Eds.). (2002). Organic agriculture, environment and food security (No. 4). Food & Agriculture Org.

[11] Yagi, K., Tsuruta, H., Kanda, K.I., & Minami, K. (1996). Effect of water management on methane emission from a Japanese rice paddy field: Automated methane monitoring. Global Biogeochemical Cycles, 10(2), 255-267.