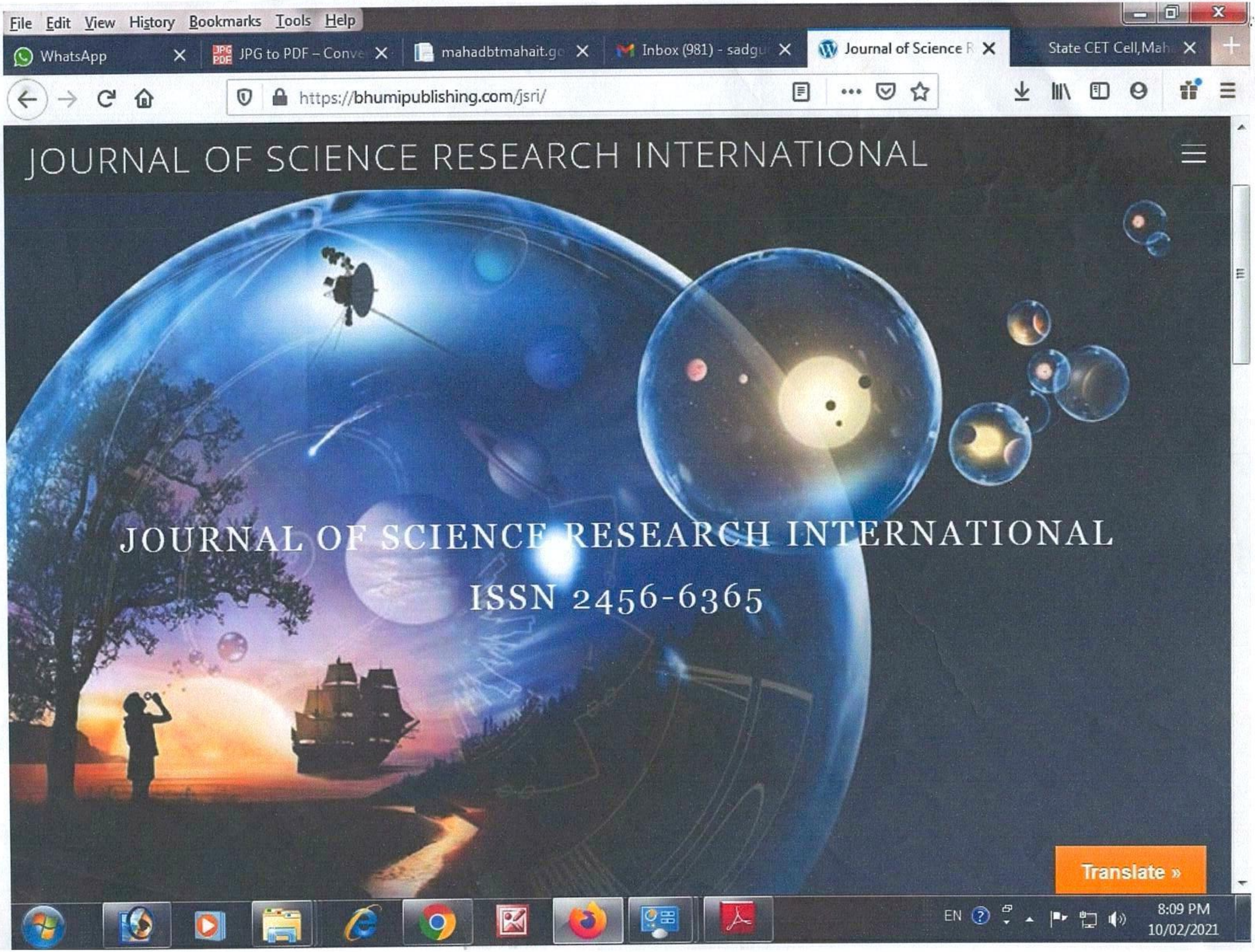
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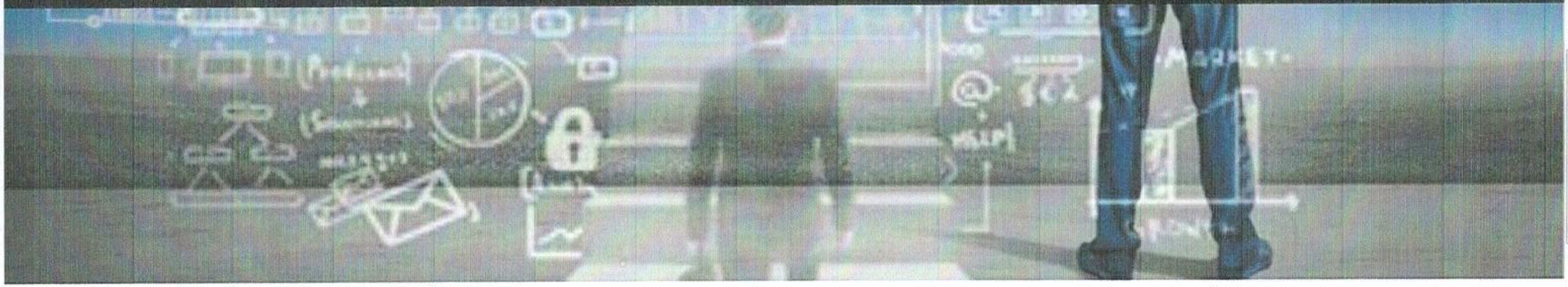

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ORIGINAL RESEARCH ARTICLE

IMPACT OF FERTILIZERS ON EMISSION OF GASES IN GREEN HOUSE FARMING AND ITS SIGNIFICANCE ON GLOBAL WARMING

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ABSTRACT:

This research analyzed the effect of organic fertilizer on the greenhouse gas emission, including carbon dioxide, methane, and nitrous oxide emitted from green house farming. Sweet Corn variety of maize plant was planted in green house farms in study area. It was divided into four different sectors such as control plots without added fertilizer, plots with the addition of organic fertilizer (cow manure), plots with the addition of organic fertilizer pellets and plots with the addition of chemical fertilizers. The results showed that the carbon dioxide, methane and nitrous oxide emission rates in the chemical fertilizer plot were the highest at 497.11, 1.81and 1.19 $mg/m^2/day$, respectively. The second highest levels were with the addition of manure at 381.54, 1.44 and0.79 $mg/m^2/day$, respectively. To reduce greenhouse gas emissions from green house farming, it is recommended that organic fertilizer must be utilized instead of chemical fertilizer, which also has good benefit on the health of farmers.

KEY WORDS:

Global warming, Chemical fertilizers, Greenhouse gas, Organic Fertilizer, Farming

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INTRODUCTION:

The literature survey reveals that, Green house farming were the highest producers of gases like carbon dioxide, methane, nitrous oxide, hydro fluorocarbon, per fluorocarbon and sulfur hexafluoride. The India, as an agricultural country, average amount of total gases emitted per year causing Global warming is 57.7%[12].The study showed that the amount of carbon dioxide emitted by the transportation sector was 229.08 million tons[8], constituting 69.9% of the total amount of greenhouse gases, whereas the agricultural sector ranked second for greenhouse gas production, contributing 22.6%.In general comparatively methane gas more easily absorbs infrared rays than carbon dioxide per volume which is the most prevalent greenhouse gas emission in the Green house farming, as it evolves under anaerobic conditions and through organic decomposition. Nitrous oxide results from the general use of nitrogeneous fertilizers, which decompose into nitrous oxide through the denitrification process caused by over irrigation or in rainy season[6].Thus, this study focused on the use of organic fertilizers instead of chemical fertilizers in Green house farming to reduce global warming by reducing greenhouse gas emission.

MATERIAL AND METHODS:

Plot Preparations:

Organic farming fields belonging to Sweet corn (maize variety), from Kadegaon Tehsil of Sangli District were used for the experimental work. Each plot of 20x20 meters was prepared which involved plowing to a depth not exceeding 30 centimeters and constructing a ridge in each plot to prevent thecontamination or overflow of water from adjacent plots. The seeding preparation is done as usual procedure adopted by the farmers and harvested and transplanted to the experimental plots under study.

Fertilizer Preparation:

The fertilizers used included organic fertilizer which was obtained from non contaminated Sources, pellet organic fertilizer, and chemical fertilizer (formulas 16-20-0 and 46- 0-0). A random sampling of all of the fertilizers was performed to analyze for acid-forming or nonacid-forming properties, pH, moisture content, total nitrogen, the C/N ratio and total organic carbon.

Planting and Maintenance:

The planting was divided into two stages:

1. The first stage was to plant seeds in small plots by sowing the seeds and allowing them to sprout for 30 days

2. The second stage was to harvest and replant into experimental plots. A water level of 5-10 centimetres was maintained throughout the experiment.

Application of Fertilizers:

The conditions for each experimental plot were as follows:

1. Plot without fertilizer

2. Plot with added cow manure as a Organic Fertilizer during the plot preparation at a rate of 3.13 ton/ha, at 60 days after transplantation at a rate of 1.88 ton/ and the addition of 1.25 ton/ha at the maturation and final stages

3. Initially adding pellet organic fertilizer during the farming field preparation at a rate of 0.13 ton/ha, adding pellet organic fertilizer at the vegetative stage at a rate of 0.13 ton/ha or after 60 days of transplanting the seedlings and adding pellet organic fertilizer at a rate of 0.06 ton/ha at the maturation stage

4. Adding chemical fertilizer, formula 16-20-0, during the initial stage at a rate of 0.19 ton/ha and adding chemical fertilizer formula 46- 0-0 at a rate of 0.05 ton/ha at the vegetative stageand 0.05 ton/ha at the maturation stage.

Sample Collection and Analysis:

The air was sampled during the following [9] stages: before planting, initial stage, vegetative stage, panicle-formation stage and maturation stage. Air samples were collected in a canister using the following sampling method. The chamber used was 0.6 meters wide, 0.6 meters long and 0.8 meters high, with an area of 0.29 cubic meters. Prior to the sampling period, the chamber was placed in the plots and an air pump was used to draw an air sample, which was stored in a sample bag. The air samples were analyzed for $CO_2$and CH_4 using Gas chromatography and N_2O was analyzed using flourier transform infrared spectroscopy (FTIR). TheConcentration of greenhouse gas was analyzed for flux using the following equation[4]

$$[F] = \frac{BVSTDxdCxMWx1000x60}{104x22400xAxdt} \quad \text{........ (1)}$$

$$[BV_{std}] = \frac{BVxB.P.x273}{(273+T)X760} \quad \text{................ (2)}$$

Where, F = Flux value for each gas (mg/m2/hr)

BV = Volume inside the plastic box at a point located above the flooding level (cm3)

B.P = Ambient Pressure at that time (mm Hg)

MW= Molecular weight for each gas

T = Temperature of the air in the box (0C)

A = Cross Section of the box (m2)

dC = Differential concentration of each gas at time zero and t (minute)

dt = Contact time (minute)

Statistical Analysis:

The Variation in emission of CO_2, CH_4 and N_2O emission data from the experiment was analyzed using ANOVA, and the differences of the data were compared using Duncan's new multiple range Test (DMRT). The statistical analysis was implemented.

RESULTS AND DISCUSSION:

Quantity of Greenhouse Gas Emission:

Different fertilizers were used for the experiment: organic fertilizer (cow manure), pellet organic fertilizer and chemical fertilizer (formulas 16-20-0 and 46-0-0). Both the organic fertilizer (cow manure) and pellet organic fertilizer, composed of N, P and K, were expected to affect the greenhouse gas emissions due to agricultural activity. The overall analysis concluded that the CO_2,CH_4 & N_2O were emitted at statistically significant differences ($P<0.05$).Detail of the greenhouse gas emission is shown in Table 1.

Table 1: Quantity of Greenhouse Gas Emission after Fertilizer Application in Plots

Plot	Emission of greenhouse gas (mg/m2/day)		
	CH_4	N_2O	CO_2
C control plots without added fertilizer	1.23±0.06	0.25±0.06	258.69±39.50
A plots with the addition of organic fertilizer (cow manure)	1.44±0.13	0.79±0.02	381.54±27.77
B plots with the added organic fertilizer pellets	1.38±0.08	0.47±0.05	268.65±33.9
R plots with the addition of chemical fertilizer	1.81±0.20	1.19±0.05	497.11±109.01

Emission of CO_2:

Plots with the added chemical fertilizer emitted the most CO_2gas, averaging 497.11mg/m^2/day. The lowest was found in the fields that contained cow manure as added organic fertilizer. The organic fertilizer pellet plot and control plot emitted CO_2 gas at rates381.54, 268.65 and 258.69 mg/m^2/day respectively. The CO_2 emission rates were not statistically significant different; however, the results of this study indicate that the addition of fertilizer in the plots under study increases the CO_2 emission rates. TheCO_2 emission is generated by organic decomposition in the soil under aerobic conditions. Hence, a high quantity of organic matter is an important factor in increasing CO2emissions, which corresponds to the total density of fertilizer[9]by varying the ratio for organic farming: The N: P_2O_5 ratio was varied at a level of 9.6:9.6 and 28.8:28.8, and the results indicated that the soil density increases from 1.15 gram per cubic meter to 1.39 gram per cubic meter when the ratio is increased. When adding fertilizer to the soil, both the nitrogen and soil density will increase. In the present study, the quantity of CO_2 in each plot experiment found that CO_2 emitted through Sweet corn plant as a maize variety. The panicle-formation stage displayed the highest CO_2 level, after the plot with added chemical fertilizer, which had the highest CO_2 emission during the harvest period. This finding corresponds to Redeker's [4]research, which indicated that plants of the Chain at variety had the highest emission rate (539.6 mg/m2/day) during the panicle formation stage.

Methane Emissions:

The methane emission quantity shows that, adding fertilizer in each plot affected the methane emissions. The highest rate of CH_4emission occurred in the plot with the added chemical fertilizer and measured an average rate of 1.81 mg/m2/day. The plot with the added cow manure as a organic fertilizer and organic fertilizer pellets emitted at the average rate of 1.44 and 1.38 mg/m^2/day, respectively. In addition, the control plot emitted the lowest CH_4 gas level, at the rate of 1.23 mg/m^2/day. Most of the CH_4 gas emitted by the field was generated by the microbiological decomposition in the soil. It was also found that the plants in each growth stage has a statistically significant difference in the emission rate ($P<0.05$). When compared with the CH_4 gas emission rate of each plot during the maize growth stages, we found that the maize as a sweet corn variety in the vegetative stages had the highest emission rate. In addition, the plot with the added chemical fertilizer had the highest CH_4 gas emission rate, at 3.03 mg/m^2/day. The ranking order for the CH_4 gas emission rate is the plot with added organic fertilizer pellets, the cow manure as a organic fertilizer and the control plot, at 2.88, 1.68 and 1.03 mg/m^2/day, respectively. A similar study by Ying and Tai [14]evaluated the CH_4 gas emission from pre-germinated direct-seeded lowland maize of different seed varieties combined with water management and chemical fertilizer addition during out-of-season maize growth. The results of the present study showed that the highest CH_4 gas emission rate was generated during the plant growth between 16-40 days or by the plant in the vegetative stage.

Emission of N_2O:

The control plot, added cow manure as a organic fertilizer plot and organic fertilizer pellet plot emitted N_2O at averages of 0.25, 0.79 and 0.47 mg/m^2/day, respectively. The plot with added chemical fertilizer emitted the most N_2O gas during the maize season, at a rate of 1.19 mg/m^2/day. In addition, adding fertilizer increased the N_2O gas emissions.A finding that was especially noted in the plot with the chemical fertilizer. The N_2O gas emission was directly affected by the chemical fertilizer component, the N:P:K ratio of 16:20:0 and 46:0:0, which corresponds to Stevenson and Cole[5]who studied the use of fertilizer with a high nitrogen component in agriculture, reporting higher amounts of N_2O gas emissions. Moreover, the comparison of the N_2O gas emission rate during each maize growth stage found that the plants in the vegetative stage emitted the highest amount of N_2O gas. In addition, newly germinated maize seedlings depend on large quantities of nutrients for strong and complete[2]growth. Hence, fertilizer formula 46-0-0 was added to the paddy field, and the results showed that the nitrous oxide emission was the highest during the vegetative stage because the high quantity of nitrogen in the fertilizer increased the nitrous oxide emission rate. The application of fertilizer increased the greenhouse gas emission during maize cultivation. The plot with the added chemical fertilizer formulas, 16-20-0 and 46-0-0, which are considered appropriate for maize growth[10], increased some of the greenhouse gas emissions. The highest levels of CO2 gas emission (37.64%), CH_4 gas emission (32.65%) and N_2O gas (44.83%) of the total greenhouse gas emissions during the growth are illustrated in Table 2.

Table 2: Percentage of greenhouse gas emission

Plots Emission of greenhouse gas (%) Carbon dioxide Methane Nitrous oxide

Plot	Emission of greenhouse gas (mg/m2/day)		
	CH_4	N_2O	CH_4
C control plots without added fertilizer	20.79	8.99	35.97
A plots with the addition of organic fertilizer (cow manure)	24.56	29.91	26.89
B plots with the added organic fertilizer pellets	23.50	18.29	19.48
R plots with the addition of chemical fertilizer	31.15	42.81	17.66
Total	100	100	100

The application of chemical fertilizer caused higher greenhouse gas emissions than the organic fertilizer because chemical fertilizers indirectly affect soil reactions, resulting in microbial changes that slow the decomposition of organic substances and increase the accumulation of organic substances in the soil. Moreover, the increase in organic substances contained in the soil raises the amount of CH_4 gas that will be emitted [10]. In addition, the denitrification process will be initiated, whereby nitrate is converted to nitrogen gas under anaerobic conditions by micro-organisms in the soil[12]. Therefore, to reduce greenhouse gas emissions due to organic farming, agriculturists should add organic fertilizer instead of chemical fertilizer, which would also afford benefits to the health of the agriculturists. However, it may be difficult for agriculturists to switch to organic fertilizer because chemical fertilizer results in good production and many individuals neglect to consider the negative effects on the environment. Based on this research, the highest maize production occurred under the treatment of added organic fertilizer (cow manure), and the remaining ranking order was paddy fields with added chemical fertilizer, pellet organic fertilizer and the control plots, respectively; the production for each field was 3.59, 3.34, 2.71 and 2.00 ton/ha, respectively. To promote the use of organic fertilizer, relevant agencies should provide information that is relevant to environmental effects and health impacts on both the producer and consumer. Moreover, such guidance for the reduction of greenhouse gases due to agriculture should be provided for acceptance by the agriculturist in addition to the consideration of sweet corn as a maize production. Furthermore, agriculturists should be encouraged to utilize organic fertilizer, as it results in the reduction of greenhouse gas emissions from agriculture and is considered as part of the Clean Development Mechanism (CDM) for India to reduce greenhouse gas emission. Additionally, organic fertilizer is more efficient in enriching the soil, promotes soil aeration and looseness and contains more and varied nutrients than chemical fertilizer[13]. Furthermore, modifications of water management by adding a small amount of water and draining when the rice plants reach the vegetative stage and then allowing evaporation as a natural process complies with the study of T suruta and Hirose [7]and results in the reduction of CH_4 gas and N_2O gas production.

CONCLUSION:

Effect of Fertilizer on the Quantity of Greenhouse Gas Emission:

The quantity of greenhouse gas emitted from the experimental plots indicated that plot with added chemical fertilizer had the highest emission rates when compared to all of the plots. The greenhouse gases in this study wereCO_2, CO_2 and N_2O, and the emission rates were 497.11, 1.81 and 1.19 mg/m^2/day respectively. The plot with the added organic fertilizer pellets had the lowest emission rates of 268.65, 1.38 and 0.47 mg/m^2/day, respectively. The greenhouse gas emission rates for each gas type and plot were statistically significant ($P<0.05$).

Effect of Greenhouse Gas Emission during Growth:

The study of the greenhouse gas emission from the plots also compared each growth stage, with all of the fields emitting CO_2 gas mostly during the panicle-formation stage. Furthermore, during the vegetative stage, CH_4 and N_2O were mostly emitted by all of the plots; the drainage of water from the plots after the vegetative stage resulted in decreased greenhouse gas emission in all of the plots. The lowest greenhouse gas emission ratefor all stage was found prior to the harvest stage. The difference in each maize growth stage was statistically significant.

Guidance for the Reduction of Greenhouse Gas Emission from Organic Farming:

To reduce emission of CO_2 gas, agriculturists should be encouraged to discard organic waste instead of burning, decrease plowing and provide mostly CO_2 in the carbon cycle in an organic form to slow organic decomposition and increase photosynthesis. For CH_4 gas reduction, agriculturists should avoid adding large amounts of organic fertilizer, improve soil quality by increasing aeration and drain water from the plots prior to the panicle-formation stage. For N_2O

gas reduction, farmers can add organic fertilizer instead of chemical fertilizer; however, organic fertilizer must also contain a low quantity of nitrate. Finally, the application of organic fertilizer in agriculture, especially organic farming, would protect and conserve the environment.

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REFERENCES:

1. Department of Agricultural Extension, Bangkok, Thailand, 2010.
2. Ministry of Agriculture and Cooperatives (2008), http://www. brrd.in.th/rkb
3. Technology Promotion Association (Thailand-Japan), Bangkok, Thailand, 1978.
4. Redeker KR, Wang NY, Low JC, McMillan A, Tyler SC and Cicerone RJ (2000), Science, 3:966-969.
5. Shioiri M (1942), J. Sci. Soil Manu., 16:104-116.
6. Singh JS, Raghubanshi AS, Reddy VS, Singh S and Kashyap AK (1998), Soil Biol. Biochem., 30(2):135-139.
7. Thailand Greenhouse Gas Management Organization (2000), http://www.ieat.go.th.
8. Tattao DA (1987), Doctor's Thesis, Kasetsart University, Bangkok, Thailand.
9. Thanyadee P, Maneewan M and Wananukool P (1997), Land Development Department, Bangkok, Thailand.
10. Tsuruta H, Kanda K and Hirose T (1997), Nutrient Cycling in Agroecosystems, 49:51-58.
11. United Nations Framework Convention on Climate Change (2011), http://unfccc.int.
12. Wannai S (2003), Technology Promotion Association (Thailand-Japan), Bangkok.
13. Ying YS and Tai XB (2003), Institute of Soil Science, 11:2049-2053.