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Implementing Reduced Tillage, Residue Retention and Nitrogen Rates on CO_2 and CH_4 Fluxes in Irrigated Wheat on Subtropical Floodplain Soils

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Abstract

Quantifying carbon (C) sequestration in soils is necessary to help better understand the effect of agricultural practices on the C cycle. The estimated contribution of agricultural carbon dioxide (CO_2) and methane (CH_4) to global warming potential (GWP) has a wide range. The underlying causes of this huge uncertainty are the difficulties in predicting regional CO_2 and CH_4 losses due to lack of experimental evidence on CO_2 and CH_4 emissions and associated drivers. The CH_4 and CO_2 emissions were measured in irrigated wheat in a subtropical floodplain soils which have been under two soil disturbance levels (strip vs. conventional tillage; ST vs. CT being both with 30% residue retention) and three N fertilizer rates (60%, 100% and 140% of the recommended N fertilizer dose, RD) in an annual wheat (*Triticum aestivum*)-mungbean (*Vigna radiata*)-rice (*Oryza sativa* L) for seven consecutive years. The highest CH_4 and CO_2 emission peak was observed on day 3 after urea application in both tillage systems, except for CO_2 flux in CT. Nitrogen fertilizer application rate significantly influenced mean and cumulative CH_4 and CO_2 fluxes. At the optimum dose of N fertilizer, both CH_4 and CO_2 fluxes decreased, except for CH_4 under ST. CO_2 emissions were significantly higher under minimum (60% of RD) fertilizer application in both tillage systems. Soil microbial biomass carbon

(MBC), organic carbon (SOC), particulate organic carbon (POC), permanganate oxidisable carbon (POXC), and basal respiration (BR) were significantly higher in ST which were negative and significantly correlated with CO_2. However, POC and POXC were positively and significantly correlated with CH_4 emission.

Subject Areas

Soil Science

Keywords

Carbon Dioxide Emissions, Methane Emission, Nitrogen Rate, Tillage, Residue Retention

1. Introduction

Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are the most important GHG gases from agriculture. In agriculture, gas emissions are effectively balanced, while in photosynthesis, the plant binds the same volume of CO_2 as it exhales in decomposition. The emissions of GHG from wheat processing amounted to 2210 kg $CO_2 \cdot ha^{-1}$ [1]. The effects of N fertilization on greenhouse gas exchanges in the soil atmosphere have been extensively studied, but the findings have not been reliable, ranging from positive to negative in various studies [2]-[4]. These variations have hampered the precise assessment of global flows of greenhouse gases [5]. The response of soil greenhouse gas fluxes to N addition has been recorded to depend on the N status of ecosystems [6], or to be affected by soil properties, such as dissolved organic matter or ratio of N to the nutrients [3] [7] [8]. Soil organic carbon (SOC) is a very important soil property and could affect soil greenhouse gas flux responses to N addition through coupling between cycles of carbon and N [8] [9]. Nevertheless, N fertilization and SOC interactions on soil greenhouse gas fluxes have rarely been studied. An increasing technology in the world is the adoption of reduced tillage (e.g., strip tillage, ST; and minimal tillage, MT) [10]. To increase soil organic carbon (SOC), water retention [11] and C sequestration [12] in the soil, strip tillage has been registered. Increased C sequestration caused by conservation activities is sometimes coupled with decreased soil CO_2 emissions [13]; other authors have observed higher soil breathing rates under ST [14]. The history of tillage procedures should also be taken into account [15]. No agreement has yet emerged on the effect of tillage practices on GHG fluxes. The main objectives of the present study were (i) to identify the influence of tillage on wheat CO_2 and CH_4 after 8 years of contrasting nitrogen dose tillage practices in different floodplain soils, and (ii) to assess the effects of tillage and N rates on the consistency of the substrate and their related effects on CH_4 and CO_2 fluxes.

2. Materials and Methods

2.1. Description of the Experimental Site

The study was conducted on the Research Field of Bangladesh Agricultural University (BAU), Mymensingh (24˚43.407'N, 90˚26.22'E), Bangladesh. The region is under subtropical monsoon climate with a mean annual temperature of 26˚C, average annual rainfall of 1800 mm, and relative humidity of field belongs to a Non-calcareous Dark Grey Floodplain soil under the agro-ecological zone 9 (AEZ-9; Old Brahmaputra Floodplain soil) [16] and classified in the U.S. Soil Taxonomy as Aeric Haplaquept, moderately drained with silt loam texture and near neutral pH (6 to 6.5).

2.2. Experimental Design and Cultural Management

The experimental field has been managed under a conventionally ploughed system for many years with annual rice-rice sequence. The experiment was commenced with two soil disturbance levels (strip tillage, ST vs. conventional tillage, CT) and three N fertilizer rates: 60%, 100% and 140% of recommended N fertilizer (optimum dose, 100 kg N·ha^{-1}) as urea under annual wheat (*Triticum aestivum*)-mung bean (*Vigna radiata*)-rice (*Oryza sativa L*) cropping sequence. The ST has been performed by a versatile multi-crop transplanter (VMP) which makes a 3 cm furrow after each 20 cm unploughed strip. In ST system, 30% residue (by height) of the previous crops for wheat and rice and 100% for mung bean were left on soil surface while in CT system same amount of residue was incorporated into soil by repeated ploughing using a power tiller. A split-plot experiment was established with three replications for each treatment combination. Tillage treatment was assigned to main plots and fertilizer to sub-plots. The size of each plot was 7 m × 7 m with a 50 cm buffer between plots. Total number of plots were (tillage x N rate x replications = 2 × 3 × 3) = 18.

Nitrogen fertilizer (urea) was applied in two equal splits at 7 and 35 days after sowing for wheat, as a single starter application for mung bean, and as three equal splits at 10, 30 and 50 days after transplanting for rice. Other nutrients, namely P (triple super phosphate), K (muriate of potash), S (gypsum), Zn ($ZnSO_4 \cdot H_2O$), and B (H_3BO_3), were applied at 20 kg P, 60 kg K, 10 kg S, 2 kg Zn, and 1.5 kg B·ha^{-1} for wheat; 20 kg P, 30 kg K, and 10 kg S·ha^{-1} for mung bean; and 10 kg P, 30 kg K, 10 kg S, and 2 kg Zn·ha^{-1} for rice. Herbicides: Glyphosate (Roundup®), a nonselective herbicide, was sprayed over the field at a rate of 1.85 kg·ha^{-1} at 2 to 3 days before the transplanting of rice seedlings or the planting of wheat and mung bean. In addition, Pretilachlor (Superhit®, post emergence herbicide) was used at a rate of 450 g·ha^{-1} at 5 to 7 days after transplanting rice seedlings in ST. Insecticides: Brifar 5G was applied 50 days after planting of wheat, Diazinon was sprayed three times for mung bean (36, 48, and 59 days after planting), and Brifer 5G and Cidial 5G were applied to control rice insects. Irrigation was provided twice for wheat, once during the crown root initiation and again before the flowering stage, depending on soil moisture and crop water requirement. The rice fields were irrigated a day before the final land preparation and as and when necessary during the growing stage.

2.3. Treatments Application and GHG Sampling

The field measurement of CH_4 and CO_2 was conducted during December to March after seven consecutive years of the same treatment application with the same cropping sequence. The CH_4 and CO_2 fluxes were measured using the static chamber method [17] beginning from the first irrigation water supply followed by the first split application of urea to until maturity of wheat. The soda glass chambers wrapped with a reflecting paper (40 cm × 40 cm wide and 40 cm high) and with stainless steel collars were inserted into the centre of each plot (7 m × 3.5 m) to a depth of 10 cm. Each collar had a neoprene seal which ensured an air-tight seal between the chamber lid and footing. At each sampling event lids were installed on the collars and gas samples were collected through the air tight rubber septa using a 20 ml polypropylene syringe equipped with a 25-gauge Luer lock needle at 30 min interval: at time 0, 30 min and 60 min. A 16 ml sample was collected from the headspace and injected into a pre-evacuated 12 ml vial (Labco Wycom Ltd.). Gas samples were collected from day 0 to 15 after each time urea application; on day 0, 1, 3, 5, 7, 10 and 15 and once a week until tillering stage of wheat.

2.4. Soil Sampling and Analysis

Composite soil samples were collected adjacent to each gas sampling chamber using an auger and a core sampler to 0 - 15 cm depth and stored in sealable plastic bags in a cooler box. A portion of field-moist soil was processed after sieving through a 2 mm mesh to remove visible organic residues and analyzed for MBC and associated biological properties. The other portion of the field-moist soil was air-dried under shade at room temperature (~25˚C) for two weeks and processed (2 mm sieved) to analyze for selected physical and chemical properties. Soil bulk density was measured using core sampler (a metal ring with 5 cm inner diameter and 5 cm height) method [18]. Soil moisture content was measured by gravimetric method [19]. Soil organic carbon (SOC) was measured by wet oxidation method [20]. Soil total microbial biomass C (MBC) was determined by the $CHCl_3$ fumigation-extraction method [21] following:

$$\text{MBC (mg/kg)} = \text{EC}/\text{kEC} \quad (1)$$

where EC is the amount of extracted organic C from $CHCl_3$ fumigated soil minus organic C extracted from non-fumigated soil, and kEC is the extraction efficiency (0.45).

2.5. CH_4 Gas Analysis and Flux Calculation

Sample vials were sent to Teagasc Environment Research Center, Johnstown Castle, Co. Wexford, Ireland for CH_4 analysis. The gases were analyzed in a Varian 3800 gas chromatograph (CP-3800, Varian, Inc., Switzerland) equipped with electron capture detector using Argon (Ar) as the carrier gas. Gas flux was calculated from the change in headspace concentration over measured period using linearity: at time 0, 30 and 60 min. The Cumulative gas emissions were calculated by summing up all daily fluxes for the whole experimental period (35 days) and assuming that, where no daily data were available, the daily fluxes changed linearly.

$$Flux = \frac{dGas}{dt} * 10^{x} * \frac{V_{chamber} * p * 100 * MW}{R * T} * 10^{y} * \frac{1}{A} \quad (2)$$

where *dGas* in ppb to get concentration change over time; 10^x is recalculation, here 10^{-9} $V_{chamber}$ is volume of the chamber used; p is atmospheric pressure in Pa (100 is to convert Pa to hPa); MW is molecular weight of C; R is gas constant 8. 314 $J \cdot mol^{-1} \cdot K^{-1}$; T is temperature in Kelvin; 10^y is recalculation here 10^6 (μg); A is area of the chamber.

2.6. Statistical Analysis

A two-way analysis of variance (ANOVA) was performed using tillage and N rate as fixed variables and block as a random variable. The distribution of data for normality was checked before ANOVA. Data were statistically analyzed to ascertain the significant differences in main and interactions among tillage and C rate treatments. Post-hoc test was performed to separate differences between C rates using Tukey-Kamers multiple comparison Test. All statistical analyses were considered significant at $p \le 0.05$, unless otherwise mentioned. Pearson correlation analysis was performed to verify relationship between soil biophysicochemical properties and CH_4 and CO_2 fluxes. All the statistical analyses were performed on Statistix 10.

3. Results

3.1. Time Course of CH_4 and CO_2 Flux after Each Application of Urea Followed by Irrigation

The highest CH_4 and CO_2 emission peak was observed on day 3 after urea application in both tillage systems except CO_2 flux in CT. Nitrogen fertilizer application rate significantly influenced mean and cumulative CH_4 and CO_2 fluxes. The CH_4 and CO_2 fluxes decreased in optimum dose of N fertilizer except ST for CH_4. The CO_2 emission significantly showed higher emission at minimum (60% of RD) fertilizer application in both tillage systems. Over the sampling period, the CH_4 emissions peak was observed on day 3 after the urea application in both split applications in either tillage, except 140RD in the second split in CT for CO_2 which showed the highest peak on day 2 (**Figure 1(d)**).

In the first split, the highest peak in CT for CH_4 was much higher than in ST, being 22.32 g $C \cdot m^{-2} \cdot d^{-1}$ in 140RD in ST and 33.98 g $C \cdot m^{-2} \cdot d^{-1}$ in 60RD in CT. In the second split, the CH_4 flux was little lower than in the first split (**Figure 1(a)**). Clearly, CH_4 emission peak in CT appeared a bit later and went down to the background level earlier than the ST which made the emission peak narrower than the ST. In both tillage systems, peak went down to the ground level on day 15 after the urea application. The peak in CT for CH_4 increased with the rate of N application being the highest in 140% RD and the lowest in 60% RD whereas in ST decreased with the rate of N application being the highest in 60RD and the lowest in 100RD (Figure 1(a), Figure 1(b)). Moreover, the peak in CT for CO_2 was unstable over the sampling period for both tillage systems (Figure 1(c), Figure 1(d)).

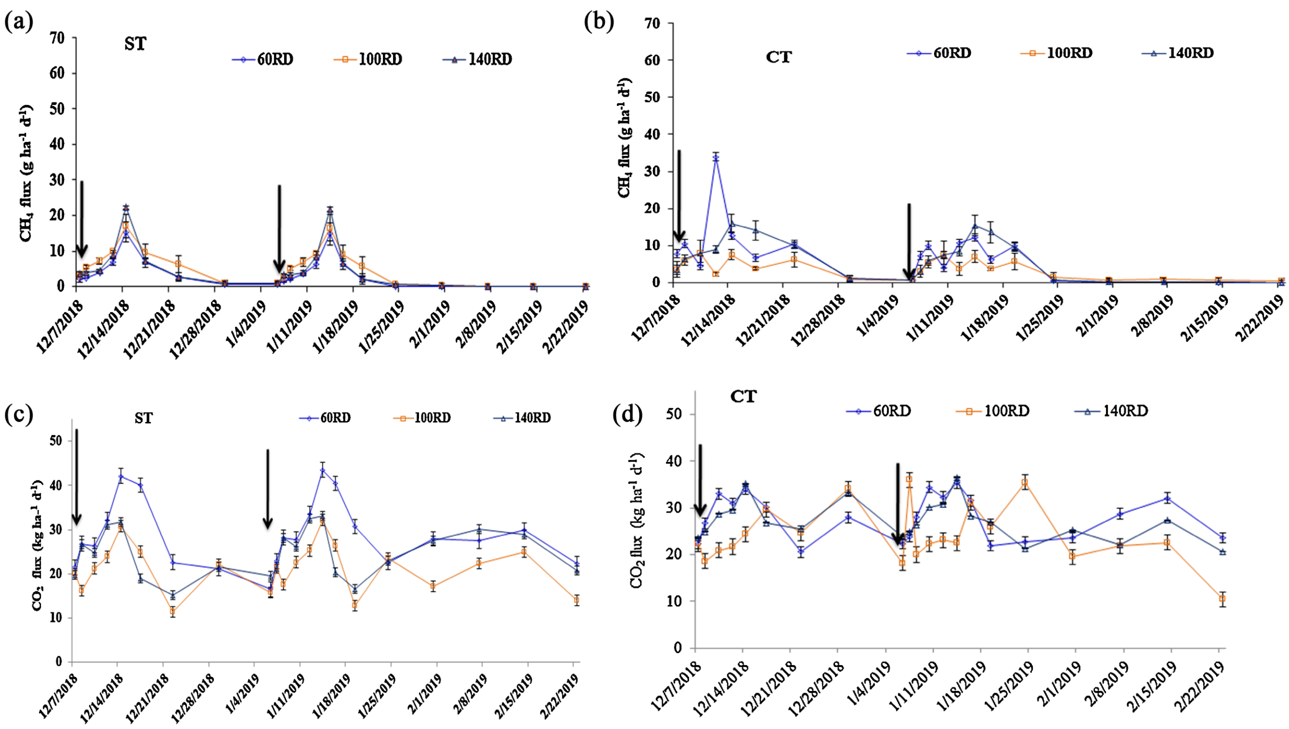

Figure 1. CH_4 flux (mean ± SE; n = 3) in three N application rates over time, day after urea application, in conventional (CT) and strip (ST) tillage systems; arrow shows the day of urea application.

3.2. Mean and Cumulative CH_4 and CO_2 Fluxes after Two Split Applications of Urea at Both Tillage Systems Following the Irrigation

Tillage had non-significant effect on both CO_2 and CH_4 emission. However, N levels showed significant variation on carbon dioxide and methane concentration. Among the interactions only N levels with tillage showed significant variation on carbon dioxide and methane. All other interactions were non-significant. The cumulative CO_2 emission significantly higher (606.52 kg $C{\cdot}ha^{-1}$) at 60RD level with ST which was statistically similar (585.95 kg $C{\cdot}ha^{-1}$) to CT with 60RD and 140RD (571.69 kg $C{\cdot}ha^{-1}$). In addition, for CH_4 emission we found that, higher GHG emissions originated mainly from the higher application rate of the N-fertilizer and 140RD observed significantly increase at ST which was similar to CT with 100RD and 140RD (Figures 2(a)-(d)). Mean CH_4 emission significantly increased with increasing nitrogen doses. However, CO_2 emission decreased significantly in optimum dose of nitrogen fertilization (Figure 3).

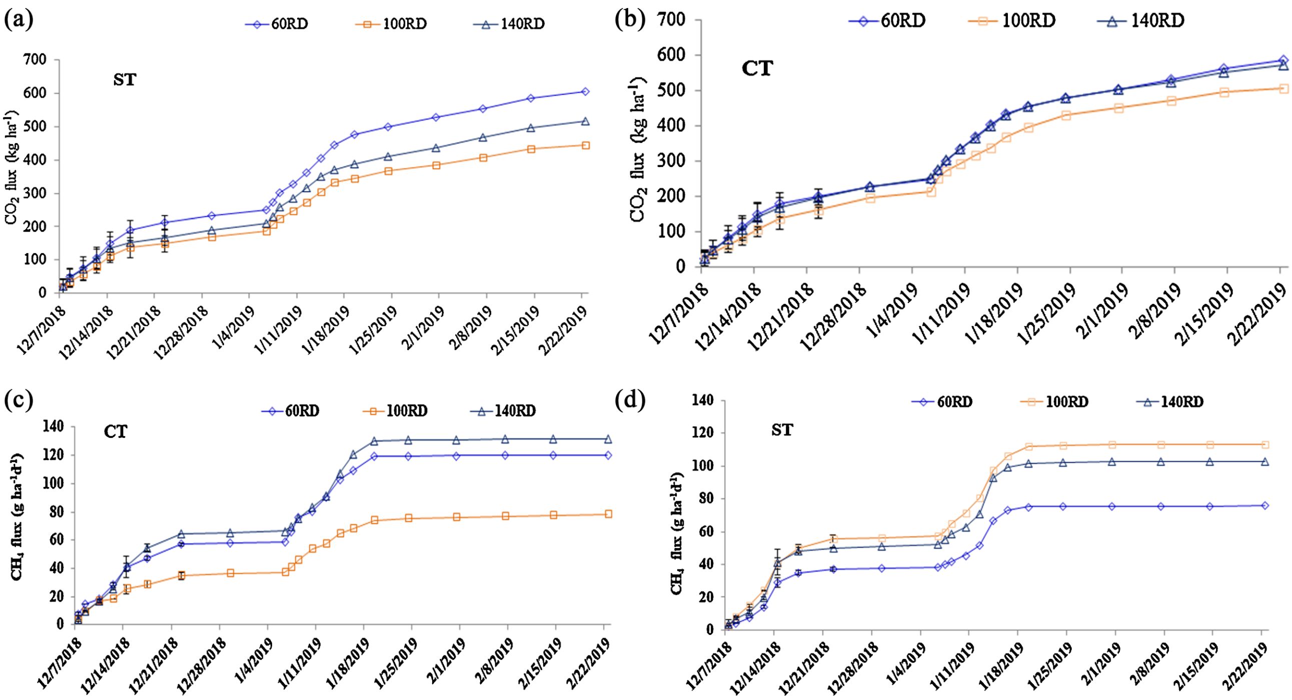

Figure 2. Cumulative emission of CH_4 and CO_2 flux (mean ± SE; n = 3) in three N application rates over time, day after urea application, in conventional (CT) and strip (ST) tillage systems.

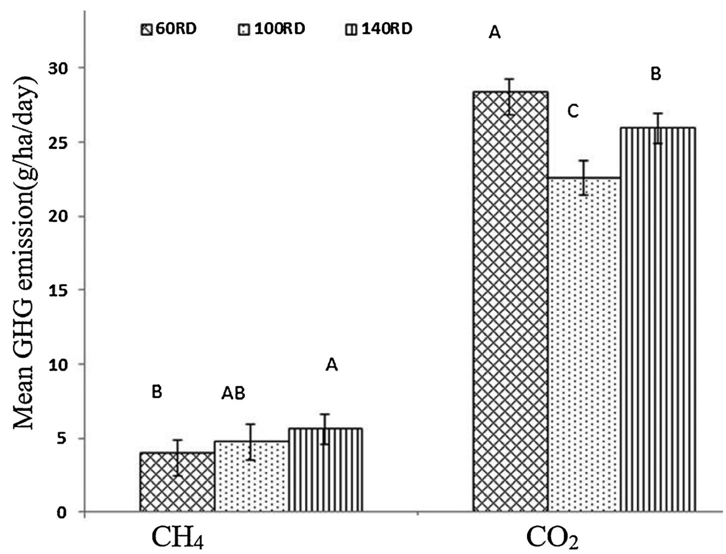

Figure 3. Mean CH_4 and CO_2 emissions in three N applications rate under conventional (CT) and strip (ST) tillage systems; small letters show differences between N rates within a tillage treatment and capital letters show differences between two tillage treatments.

3.3. Soil Physicochemical Properties under Different Tillage and N Application Rates

The measured soil biophysicochemical properties were significantly influenced by tillage and N fertilizer rates (Table 1) which is the effect of seven consecutive year's continuous application of the same treatment with the same cropping sequence. The CT had significantly higher BD ($p < 0.05$) but lower moisture than

ST. The ST significantly increased SOC, POXC, and MBC showing the mean values of 1.24%, 689.62 and 241.49 mg·kg^{-1} and 0.14% in ST and 1.01%, 548.14 and 185.2 mg·kg^{-1} in CT, respectively (Table 1). Considering the N rate, SOC and POC were significantly lower in 60% RD than in 100 ($p < 0.01$) and 140% RD ($p < 0.01$) where the latter two were similar to each other ($p > 0.05$). The MBC was significantly higher in 100% RD than in 60% RD ($p < 0.05$) and 140% ($p < 0.05$) where the later two were similar to each other ($p > 0.05$). Interaction effects of tillage and N rate were significant ($p < 0.01$) showing higher MBC in 100% RD in ST. The TN was significantly higher only in 140% RD than the other two N rates. No significant effects were found for soil moisture and basal respiration. The significant interactions between N and tillage were found only for MBC.

Table 1. Tillage and N rate effects on soil physicochemical properties (soil organic carbon (SOC), microbial biomass carbon (MBC), particulate organic carbon (POC), permanganate oxidisable carbon (POXC), basal respiration (BR), bulk density (BD), and soil moisture).

Tillage	N rate	Bulk density (g·cm^{-3})	Moisture (%)	SOC (%)	POXC (mg·kg^{-1})	POC (mg·kg^{-1})	MBC (mg·kg^{-1})	BR (mg·kg^{-1}·d^{-1})
CT	60RD	1.31 ± 0.01	35.16 ± 1.8	0.85 ± 0.06	484.22 ± 39.0	23.19 ± 2.0	154.58 ± 5.57	13.9 ± 1.04
	100RD	1.31 ± 0.01	33.2 ± 1.7	1.09 ± 0.09	577.33 ± 46.5	27.31 ± 2.4	210.43 ± 7.8	15.5 ± 1.16
	140RD	1.29 ± 0.00	31.03 ± 1.6	1.10 ± 0.01	582.86 ± 46.5	26.88 ± 2.3	190.66 ± 2.53	15.7 ± 1.17
ST	60RD	1.28 ± 0.01	38.53 ± 2.0	1.13 ± 0.02	616.89 ± 46.9	29.80 ± 2.6	243.63 ± 8.82	14.9 ± 1.11
	100RD	1.26 ± 0.00	38.50 ± 1.9	1.28 ± 0.05	702.64 ± 47.1	27.37 ± 2.4	275.43 ± 6.75	15.5 ± 1.16
	140RD	1.25 ± 0.00	37.13 ± 1.9	1.32 ± 0.01	749.33 ± 47.3	34.33 ± 2.9	205.40 ± 1.30	14.6 ± 1.10
Statistical analysis								
Tillage		*	NS	**	*	NS	*	NS
N Level		*	NS	*	*	*	*	NS
Tillage x N Level		NS	NS	NS	NS	NS	**	NS

*p < 0.05; **p < 0.01; NS = non-significant.

3.4. Relationship among CH_4 and CO_2 Flux and Soil Properties

Interrelation among CO_2 and CH_4 flux and all soil related controlling factors with their levels of significance are shown in Table 2. The CO_2 showed medium to high correlations with all the soil properties under study. There was significant negative correlation between CO_2 with soil labile carbons and microbial properties like POC, OC, POXC, BR, MBC and soil moisture. Significant negative correlations were recorded from CO_2 with soil physical property like BD ($r^2 = 0.58$). The correlation between CO_2 and other soil properties and the carbon pools ranged from 0.19 to 0.58. The lowest correlation was recorded between CO_2 and moisture ($r^2 = 0.19$). Considering CH_4 flux, we recorded all significant positive correlation with all the soil labile carbons and significant negative correlations with MBC, BR and BD. The positive correlation between CH_4 and the soil carbon pools ranged from

Table 2. Pearson correlation among CH_4, CO_2 fluxes and analyzed soil properties; soil organic carbon (SOC), microbial biomass carbon (MBC), particulate organic carbon (POC), permanganate oxidizeable carbon (POXC), basal respiration (BR), bulk density (BD) and soil moisture.

	CH_4 (g/ha/d)	CO_2 (kg/m²/d)	OC (%)	MBC (mg/kg)	POC (mg/kg)	POXC (mg/kg)	BR (mg/kg/d)	BD (g/cm³)	Moisture
CH_4 (g/ha/d)	1								
CO_2 (kg/ha/d)	−0.1412	1							
OC (%)	0.1933	−0.2934*	1						
MBC (mg/kg)	−0.0969	−0.604**	0.4726*	1					
POC (mg/kg)	0.6278**	−0.3288*	0.3886*	0.3658*	1				
POXC (mg/kg)	0.2832*	−0.5375**	0.7258**	0.6113**	0.5899**	1			
BR (mg/kg/d)	−0.0743	−0.4439*	0.1281	0.4168*	0.1082	0.2296	1		
BD (g/cm³)	−0.2253	−0.5776**	0.1544	−0.364*	−0.1411	0.0021	−0.3301*	1	
Moisture (%)	0.5581**	−0.1991	0.3482*	0.3346*	0.5071**	0.576**	0.0447	−0.1636	1

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

0.19 to 0.62. The strong positive correlation was found between CH_4 and POC ($r^2 = 0.62$) while the lowest correlation was recorded between CH_4 and BD ($r^2 = 0.19$).

4. Discussion

4.1. CH_4 and CO_2 Flux under Different Tillage Systems

In our study, there was no significant differences found between two tillages for both CH_4 and CO_2 emission. May be this is due to there were no differences regarding the size and activity of the methanotrophic community between tillage treatments as these bacteria affect CO_2 and CH_4 emission [22]. Tillage also affects gaseous diffusivity and the rate of supply of atmospheric CH_4 [23]. By contrast, CT improves macro porosity and maintains its continuity [24]. Carbon dioxide (CO_2) emissions caused by ST may be similar or slightly higher than those caused by CT if entire growing and fallow seasons are considered [25]. Reduced extracellular enzyme activities and fungal populations resulting from N fertilizer application resulted in decreased soil CO_2 emissions, our result also in line with this [26] [27]. The increased levels of surface crop residues in NT probably serve as a barrier for CO_2 emissions from soil, decreasing the decomposition of crop residues because of reduced soil temperature and minimum soil-residue contact [28]. The inconsistent tillage effects on soil CO_2 fluxes suggest that tillage is not the only factor affecting CO_2 flux and that other factors are also involved. The differences between the soil CO_2 emissions under the tillage treatments may have been caused by variation in soil C mineralization.

4.2. CH_4 and CO_2 Fluxes under Different N Rates

The application rate of the fertilizer had the biggest impact on GHG emissions.

Application of N fertilizer in our study increased CH_4 emissions from wheat field because of the promotion of wheat plant growth, providing additional C sources and emission pathways [29]. However, no significant effect of N fertilizer application on CH_4 emissions [30] [31]. On the other hand the application of urea significantly decreased CH_4 emissions [32]. Results varied among studies because of the differences in soil texture or climate. These findings show that further study is needed to understand the functioning of these complex and dynamic systems., the annual mean fluxes of soil CH_4 uptake decreased with the amount of added N, with significant differences between different treatments ($p < 0.05$). Application of N fertilizer increases plant biomass production, stimulating soil biological activity, and consequently, CO_2 emission [33]. In addition, we observed no significant effect of N fertilizer application on cumulative CO_2 emissions, consistent with the results [34]. This finding may be due to the fact that CO_2 is reduced to CH_4 under anaerobic conditions, thus leading to significant differences in CH_4 emissions rather than in CO_2 emissions.

4.3. Relationships between CH_4, CO_2 Fluxes, and Soil Properties

The results revealed that bulk density had significant negative effect on soil CO_2 flux. This relationship may be related to soil with lower bulk density levels having a greater ability to exchange air with the atmosphere due to its higher sand fraction. This study revealed that soil organic carbon content in bulk soils had a significant negative linear relationship with CO_2 flux. This indicated that abiotic and physical properties have an important role to play in soil gas exchange. This finding agrees with [35] [36]. The bulk density exhibited a negative relationship with CO_2 emission [35]. There was significant negative correlation between CO_2 with soil labile carbons and microbial properties like POC, OC, POXC, BR, MBC and soil moisture. Significant positive correlations were recorded from CO_2 with soil physical property like BD. In this study, urea fertilizer was applied immediately after irrigation water supply to the dry soil. In addition, the significant and positive correlation between CO_2 flux and soil BD implies that higher BD increases soil anaerobiocity which decrease CO_2 further to C, consequently decreasing the CO_2 flux. Higher bulk density could also create barrier to diffuse up CO_2 to the surface with reduction of CO_2 to C. The CH_4 production may occur wherever organic matter is degraded under anaerobic conditions. It is generally accepted that CH_4 production, which is part of total C mineralization, is influenced by both the quality and quantity of organic matter present [23]. However, the relationship between CH_4 production and total C mineralization is highly variable. Soil organic matter is the main substrate for methanogens [23], while others believe that recent plant residues or fresh plant materials (either the current or the previous year's production) are the main substrates [37].

5. Conclusion

To formulate effective target mitigation policies and practices, it is imperative to develop agricultural technologies that minimize CH_4 and CO_2 emissions while at the same time reducing fertilizer N application. A seven-year consecutive maintenance of strip tillage with crop residue retention on the soil surface has significantly increased mean CH_4 fluxes over CT in irrigated wheat. Likewise, CH_4 fluxes linearly increased with the increase in N fertilizer (urea) application rates. Conversely, CO_2 showed a decreasing trend with low and increasing N fertilizer rates. Seven years of continuous practices of tillage with crop residue retention have significantly improved soil OC, MBC, POC, POXC and soil moisture which were significantly correlated with CO_2 and CH_4 fluxes.

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Author Contributions

Rafeza Begum: Conceptualization, Methodology, Investigation, Soil and gas sampling and analysis, Data curation, Formal analysis, Writing—original draft;

Mohammad Mokhlesur Rahman: Methodology, Investigation, Supervision, Writing—review & editing;

Md. Mahbubul Alam: Investigation;

Md. Khyrul Islam Bashar: Writing—review & editing;

Md. Hafizul Islam: Investigation;

Abdul Awal: Formal analysis;

Md. Afnan Hossain Chy: Data interpretation;

Shah Mohammad Kamrul Hasan: Visualization.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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