Effect of AWDI Practices on Methane Gas Emission in a Small Scale Lysimeter Experiment (2013)

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Outline of Today`s Presentation

- Introduction
- Objective
- Material and Methods
- Results and Discussions
- Conclusion
- References

1)Introduction

Rice is considered as one of the most important cereal crops that can emit huge amount of greenhouse gases like methane, (CH_4) and nitrous oxide (N_2O) (Zhang et al., 2010)

According to IPCC report of 2007, agriculture contributes about 14% GHG gas emission annually

The experiment conducted in the paddy field shows that emission rate of CH4 differed markedly with soil types and application of compost (Yagi,K.et al., 2012), water management like intermittent drainage can be an appropriate technology option to reduce the greenhouse gas from paddy field (Hadi, A.et al.,)

Whenever the water from lysimeter is drained, there is percolate of soil organic and nutrients that make the decreased in CH4 gas emission (Yagi et al., 1998)

GHG emission is reduced when intermittent irrigation was done (Noborio, K. et al). But there is not clear understanding of GHG emission from the soil layer

1.1 Research Objective

- The major investigation will be conducted to clarify the effect of *AWDI practices* on methane gas emission focusing on the soil layer character

- For this research, the GHG will be trapped and compare with several parameters: *Soil temperature*, *soil redox potential (ORP)*, *soil pH*, *Soil moisture*, *ponding depth* which are affected by water management in the paddy field

1.2. Research Hypothesis

- AWDI practices will reduce the methane gas emission in comparison with conventional practices.

The emission of GHG is differs from Soil layer condition (Soil Eh, pH, temperature, moisture content)

2) Material and Methods

2.1. Study site

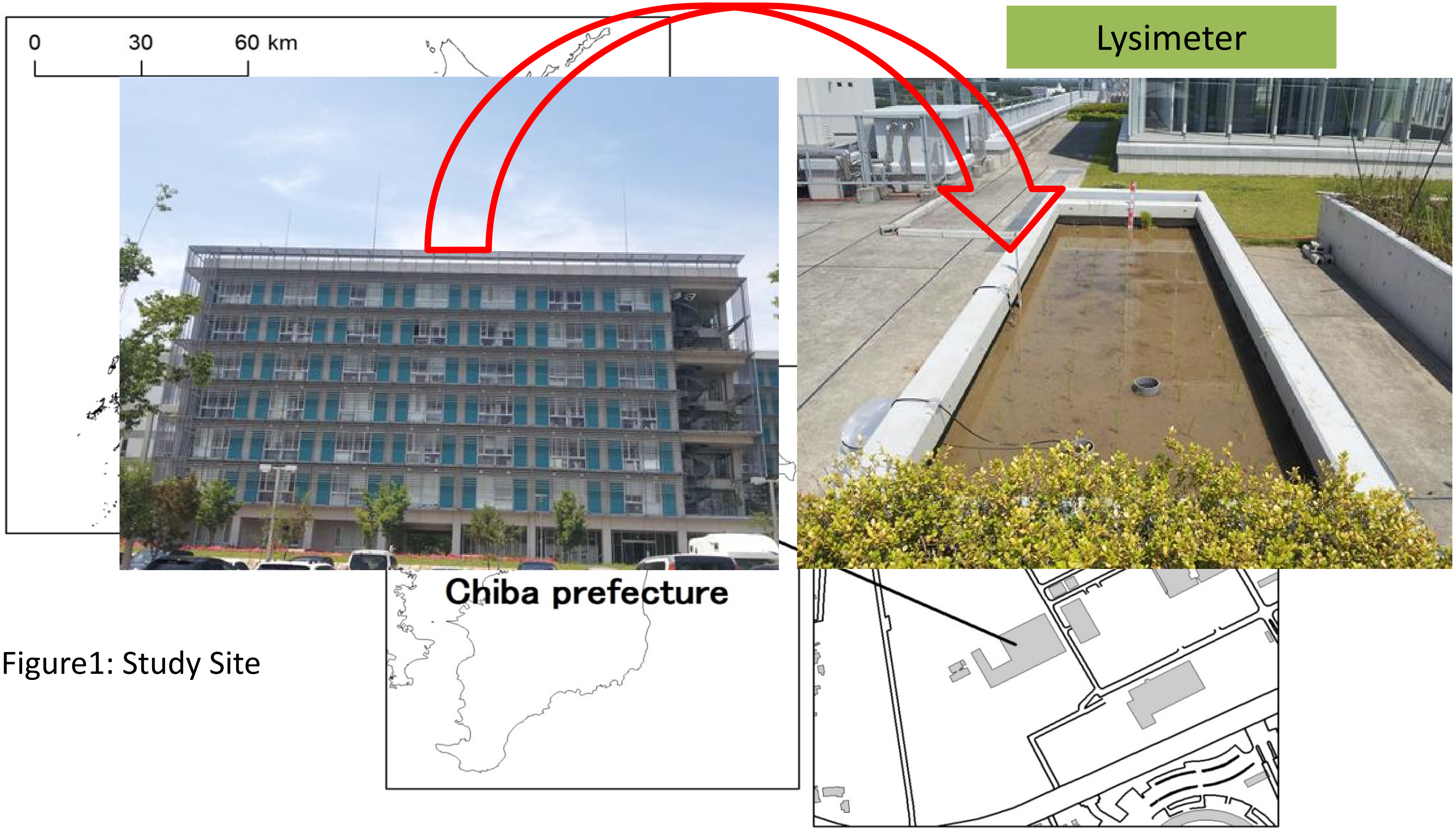


Figure1: Study Site

Field work: May 29th 2013 to Dec, 2013, **Rice transplanted**: *Koshihikari*
Continue measurement: Soil moisture and temperature in every hour and **Measurement in situ condition:** pH, ORP and water tube (every day), gas sampling depending on the ponded depth. Gas sampled 7/23,8/2,8/10, 8/24,10/11,11/24,12/26

2.2. Climatic Features of Study Area

Table 1

Months	Rainfall (mm)		Temperature (Degree Celcius)			Sunshine (hours)
	Total	Daily Maximum	Average	Daily Maximum	Daily Minimum	Total hours
April	163.5	59.0	13.0	18.2	7.2	203.6
May	70.0	22.0	17.5	23.4	12.7	250.6
June	171.0	38.0	20.8	25.3	17.5	120.4
July	48.5	24.0	24.9	30.2	21.2	178.2
August	88.0	49.0	27.2	32.5	23.2	242.4
September	166.0	60.5	22.8	27.9	18.6	173.8
October	516.5	196.5	17.7	21.9	14.3	126.3
November	26.0	8.0	10.4	16.3	5.1	177.5
December	54.0	19.5	5.2	10.8	0.4	192.1

Source: Abiko Meteorological Institute

- ✓ In general, Japan has a rainy and highly humidity.
- ✓ The total rainfall during the rice farming season was June (171.0 mm) and maximum daily rainfall was 60.5 mm. The average maximum temperature was on August i.e. 27.2 degree Celsius and daily maximum was also recorded in same month. The maximum sunshine hours is recorded on August.

2.3. Sample Collection and Instrumental set up

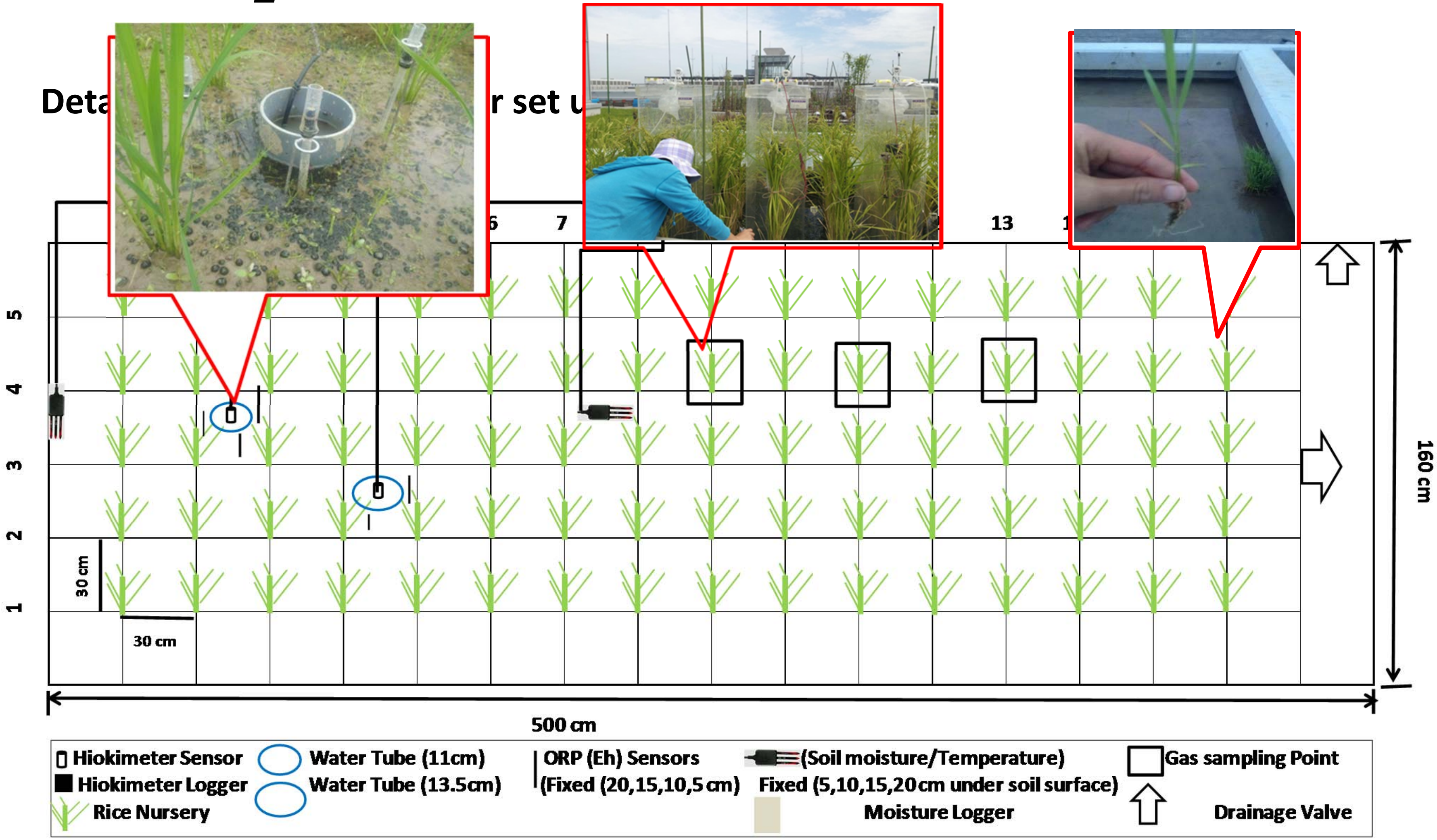
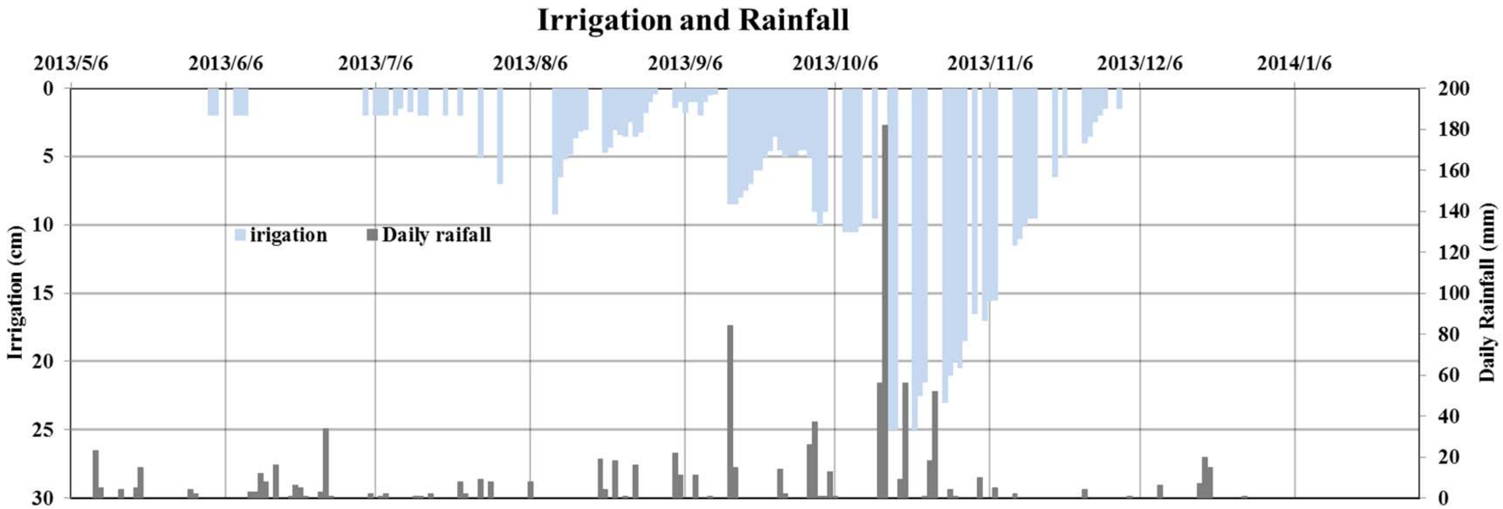


Figure 2: Instrumental Setup

3)Results and discussion

3.1. Ponding depth and rainfall

a



b

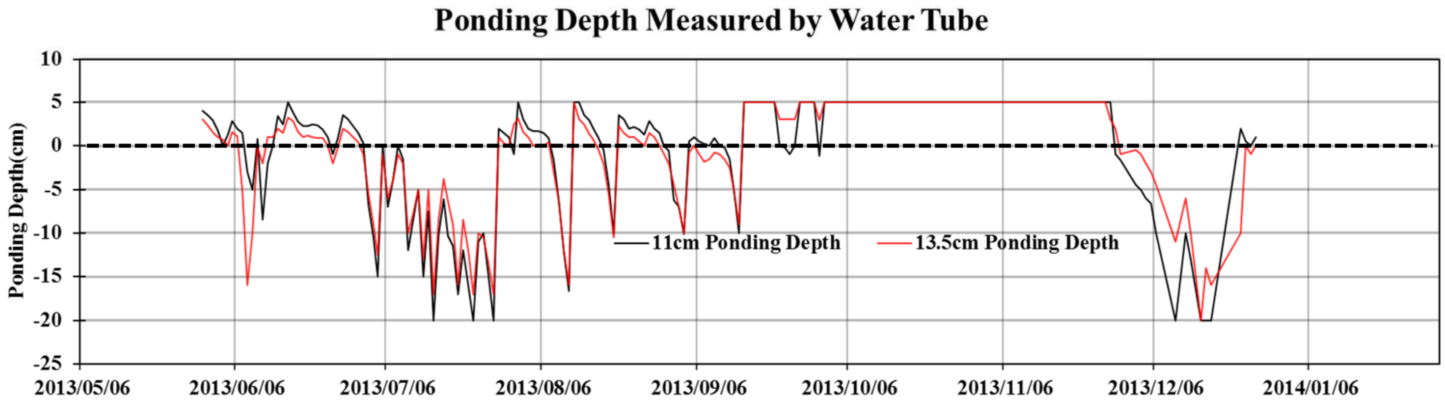
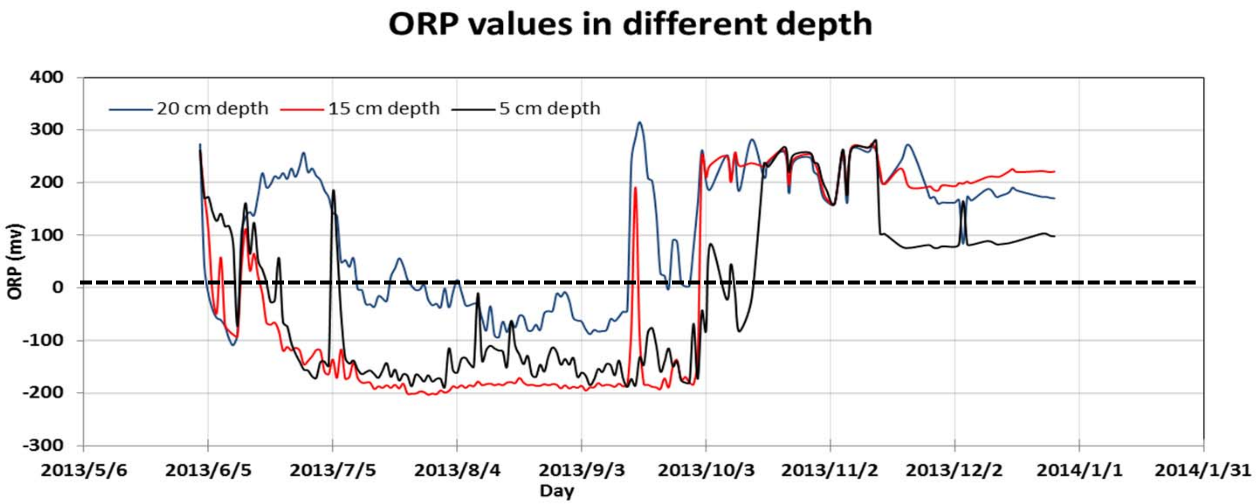


Figure: 3. a and b (Irrigation and Rainfall event during experiment, 2013)

3)Results and discussion

3.2. Redox potential (Eh) and Soil pH

c



*pH value is constant until mid of July. After the mid of July, pH value shows slightly alkaline and increasing.
the ORP value is highly fluctuating in initial phase because of soil solution mixed in plow layer and oxidation ability of rice roots.
*After the mid of July, Eh drops gradually in every depth
because of vegetative phase and active development of rice plant.

d

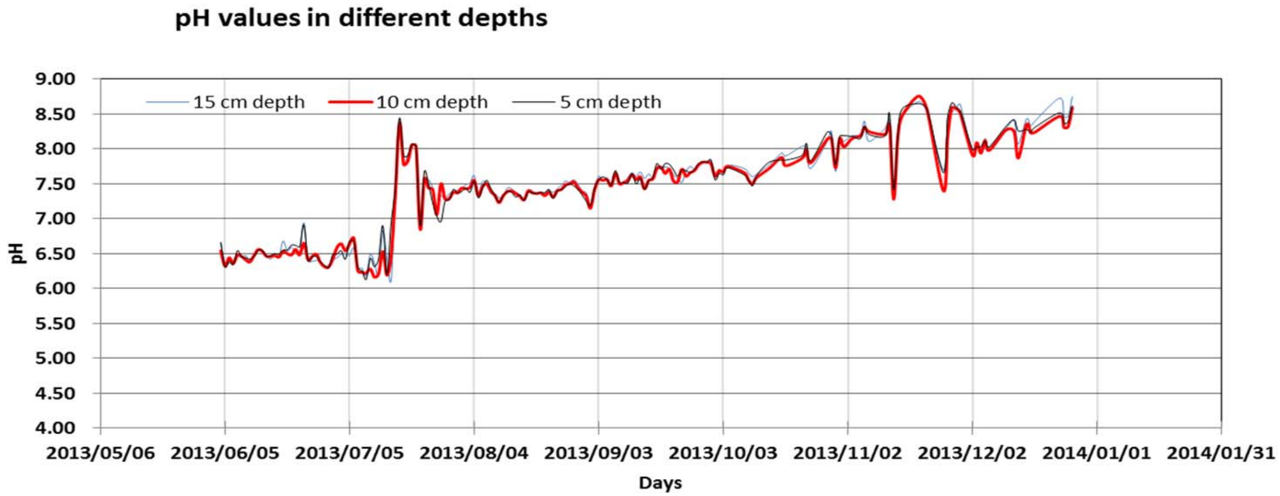


Figure: 3. c and d (Eh and pH throughout the experiment, 2013)

3)Results and discussion

3.3. Soil moisture and temperature (depth wise)

e

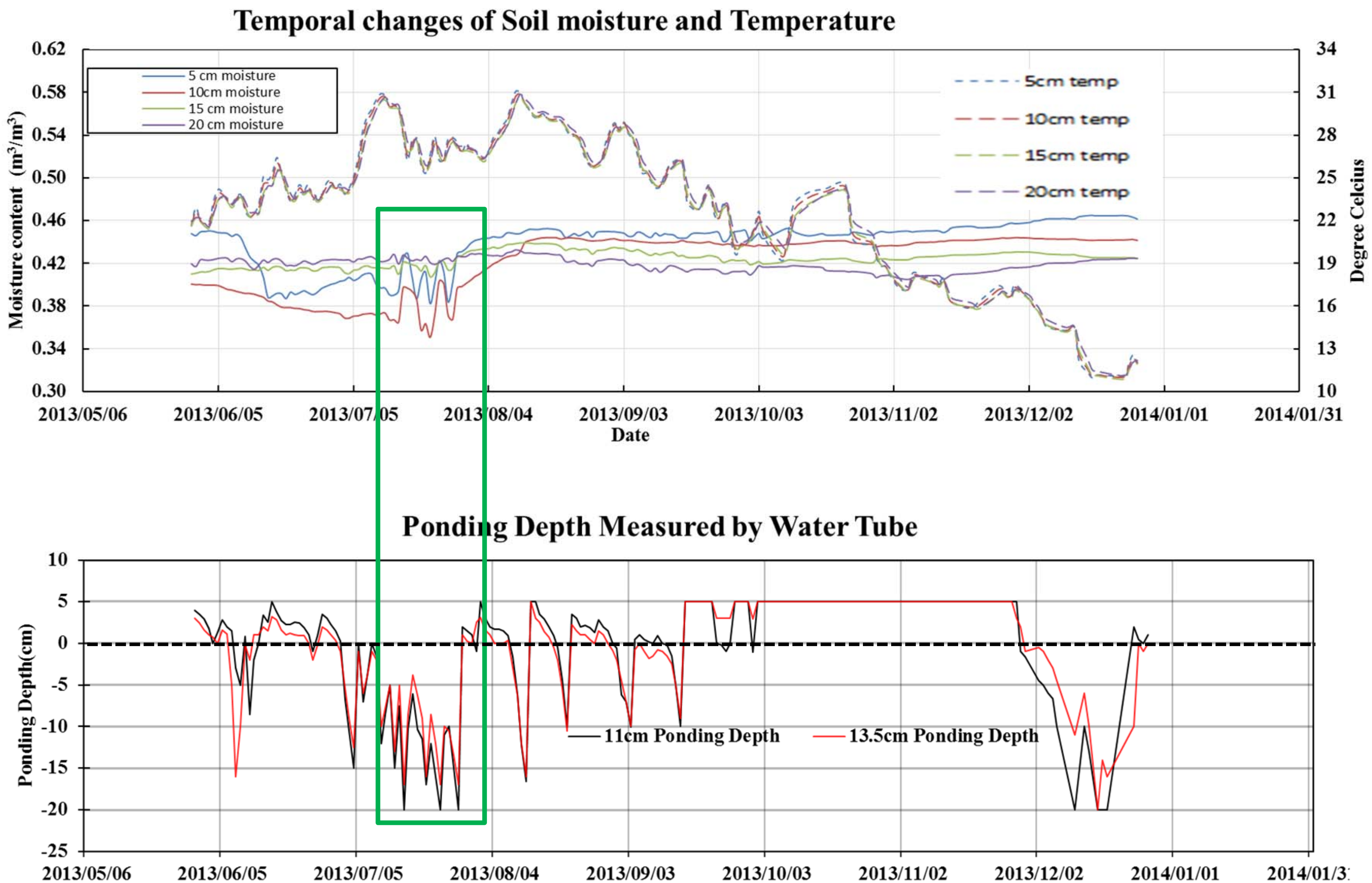
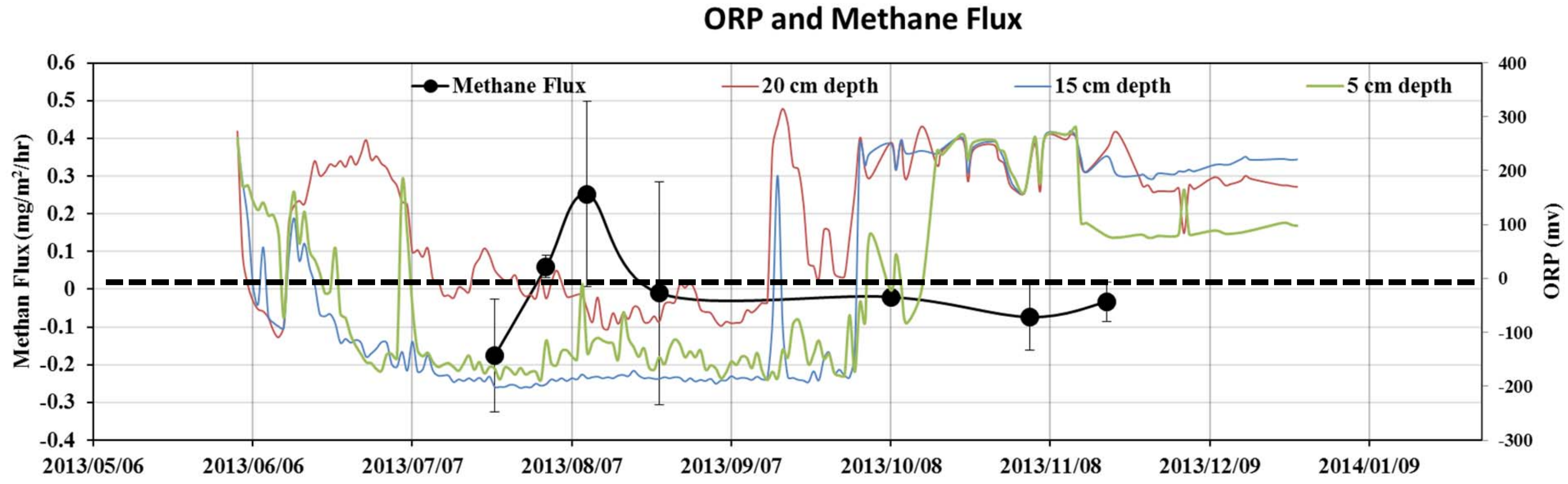


Figure: 4. e (Temporal changes of Soil moisture and Temperature, 2013)

3)Results and discussion

3.4. Methane Emission

f



g

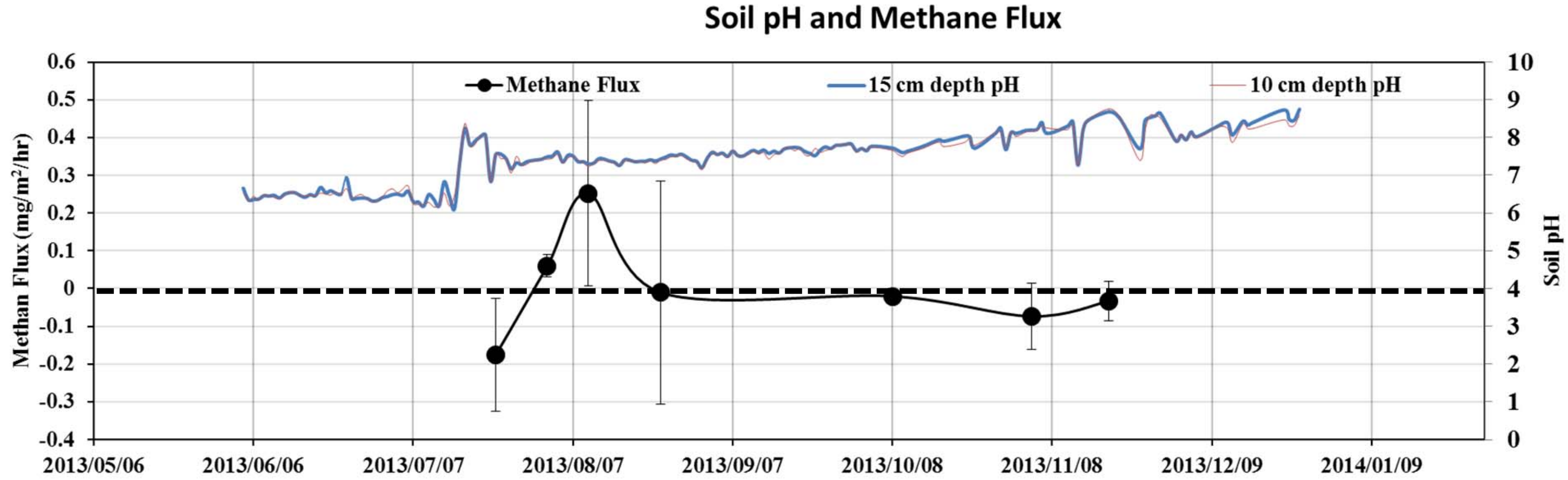
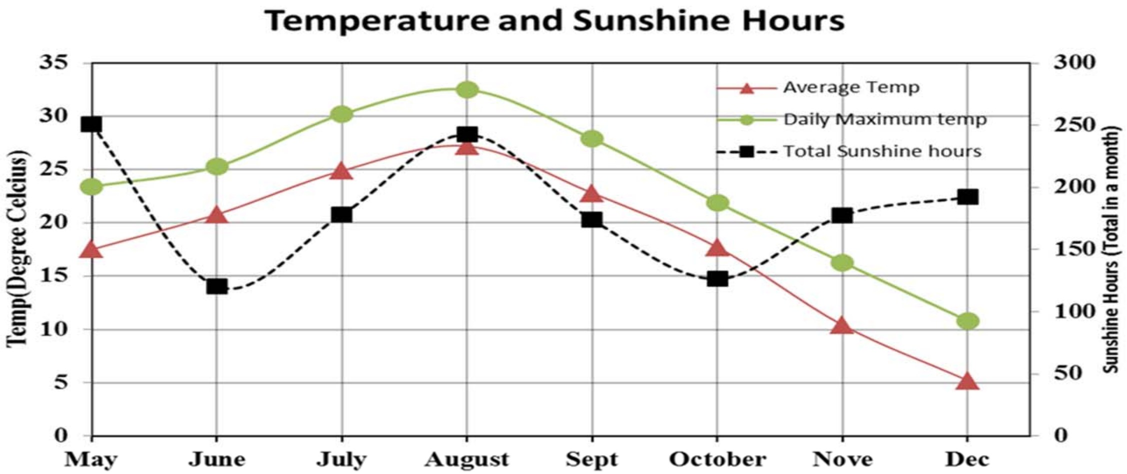


Figure: 5. f and g (Eh and ORP throughout the experiment, 2013)

3)Results and discussion

3.4. Methane Emission

h



i

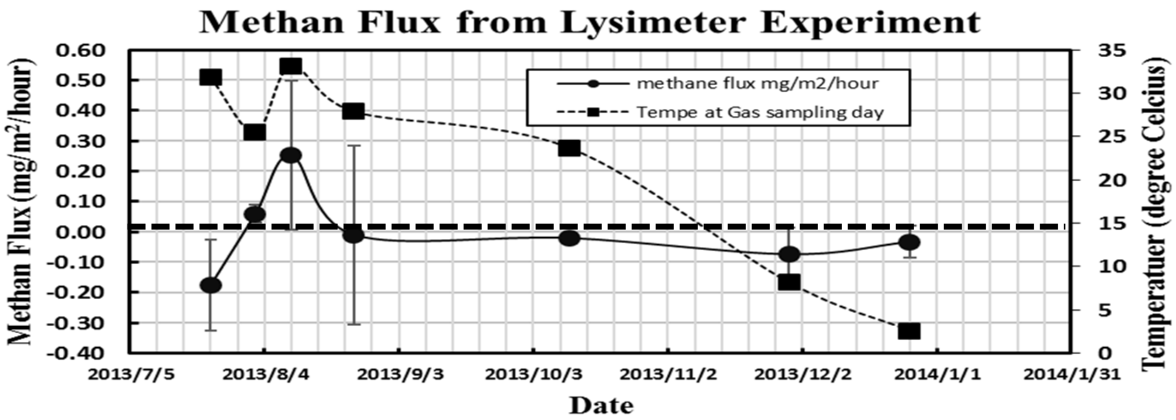


Figure: 5. h and i (Total sunshine hours and methane flux during the experiment, 2013)

3)Results and discussion

3.5. Plant growth measurement and Yield Component

Table 2.

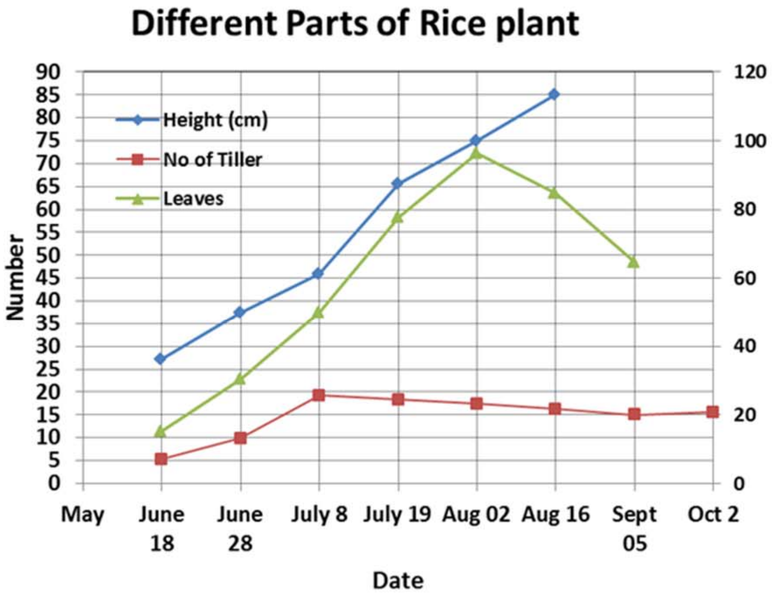
Sample number	Plant height	No of leaves	No of Tillers/stems	No spikelets	No of Grain
7B	55.83	57.00	13.75	17.50	889
7C	54.50	56.43	14.38	14.25	942
7D	55.83	62.57	14.75	14.50	846
8B	54.08	50.14	12.63	15.00	886
8C	54.33	53.71	14.00	15.50	948
8D	58.75	73.86	16.50	16.50	964
11B	56.25	67.14	16.00	16.25	1083
11C	58.00	56.86	14.88	12.75	884
11D	57.58	62.29	14.88	13.75	804
12B	56.66	60.00	14.13	16.00	1094
12C	54.50	64.86	15.00	16.25	917
12D	56.66	53.71	14.50	15.50	1063
average	**56.08**	**59.88**	**14.62**	**15.31**	**943.3**
SD	**1.54**	**6.65**	**1.01**	**1.33**	**93.6**

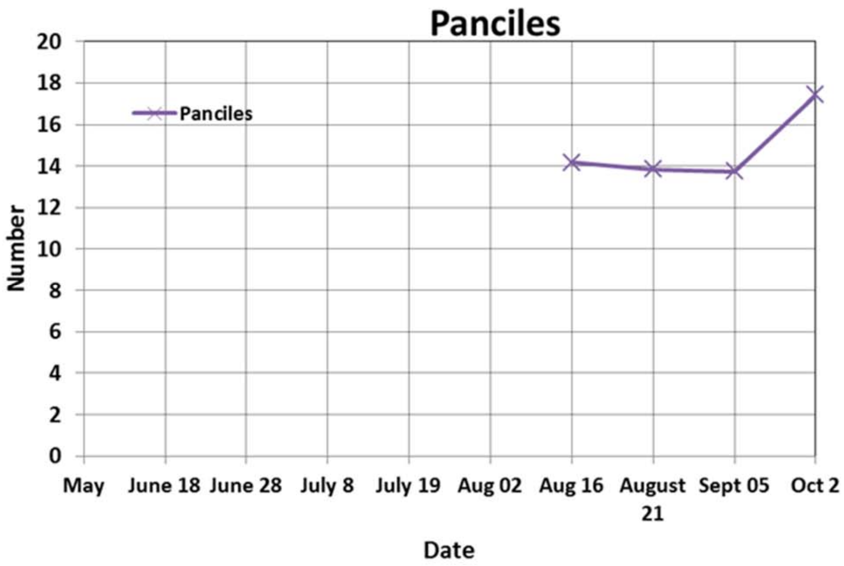
The total average grain weight from per hill is found to be 19.66 gram.
When it is converted area in hectare , rice production with husk (in ton) is 1.57

3)Results and discussion

3.5. Plant growth measurement and Yield component

j





4) Conclusion

- The mechanism of methane gas emission from paddy field is depend on the soil characters. Soil characters mean the soil pH, ORP (oxygen level) and moisture content.
- The experiment conducted in lysimeter showed that whenever soil ORP (oxygen level) is low in the soil layer, there is methane emission. When the ORP is higher (positive value), the methane emission is lower.
- It is also shown that from the temporal measurement of ORP in different depth (5cm, 15cm, and 20 cm) vary from each depth. To have a clear methane flux from soil surface, the ORP values should be lower (minus) in every depth of soil layer.
- Even after the rice harvest, it was supposed to be higher emission from the root decaying of rice plant but the results showed that there is no methane emission.
- Further research is needed to clarify whenever there is no methane emission, what will be the other GHG like N2O and CO2 gas emission and effect of other factors like physical structure of drainage valve (surface drainage or drainage from the bottom of paddy field).

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Results and discussion

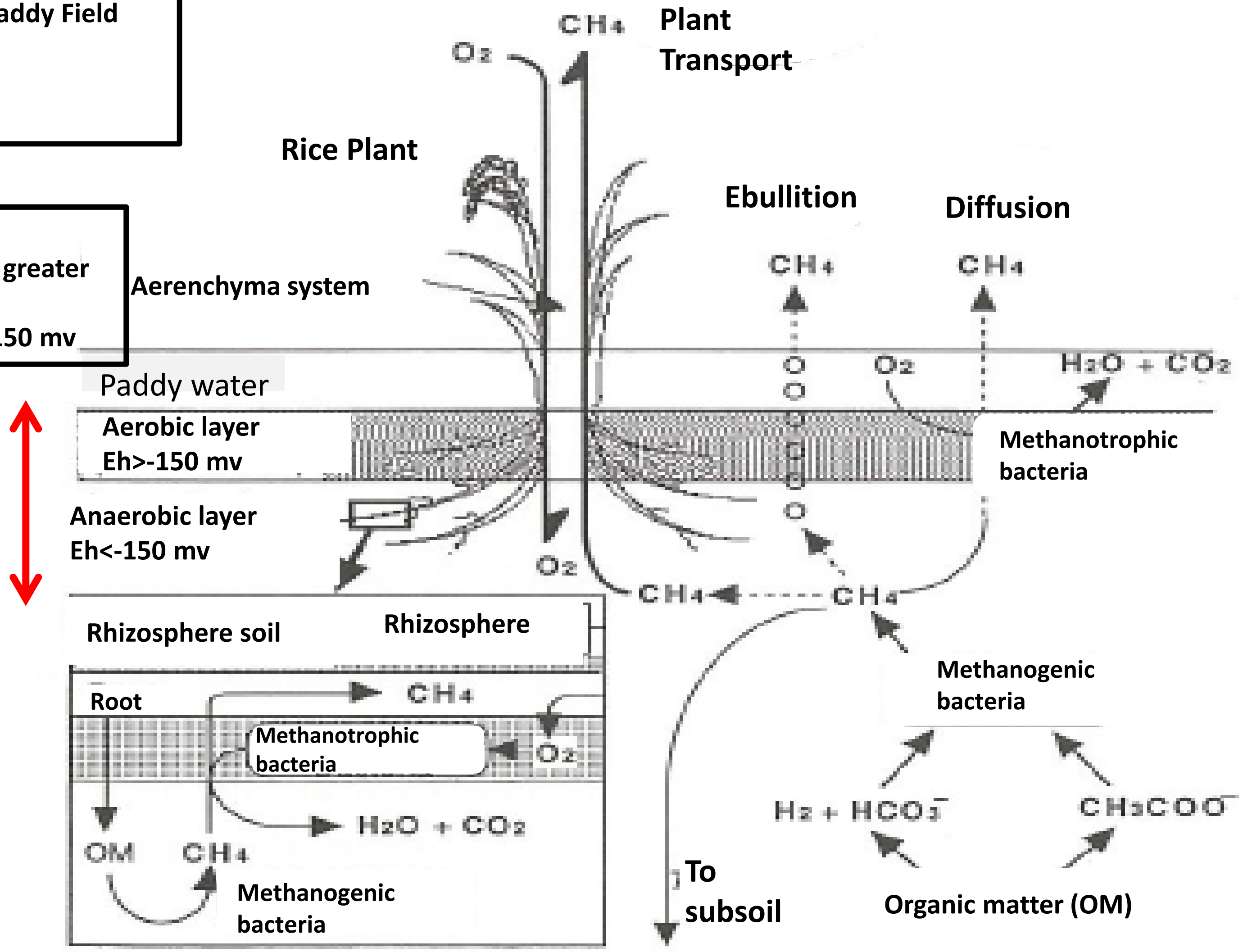
Mechanism of Methane emission from Paddy field

Soil Pro file of Paddy Field

1. Ploy Layer
2. Plowsole
3. Subsoil

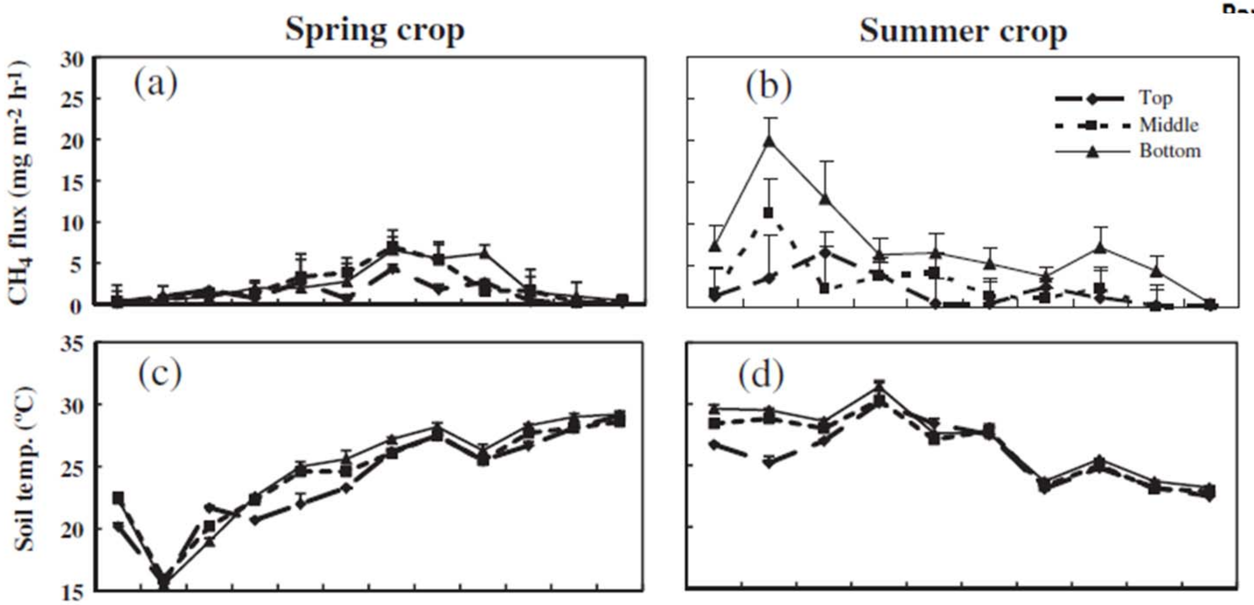
Eh (ORP)
(5-15) cm= almost greater than -150 mv
20 cm= less than -150 mv

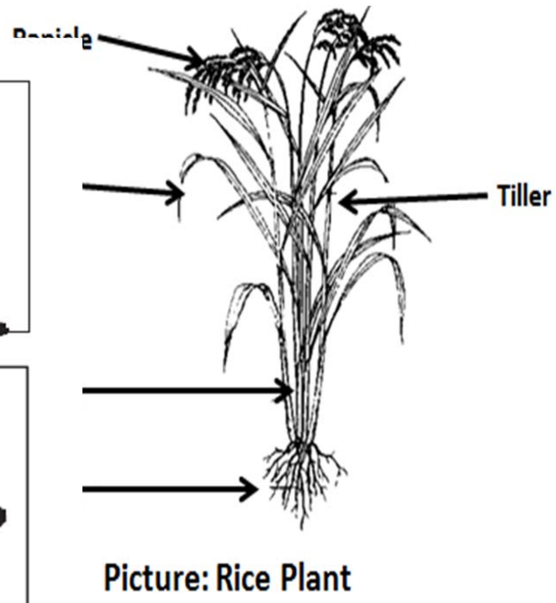
Plow Layer



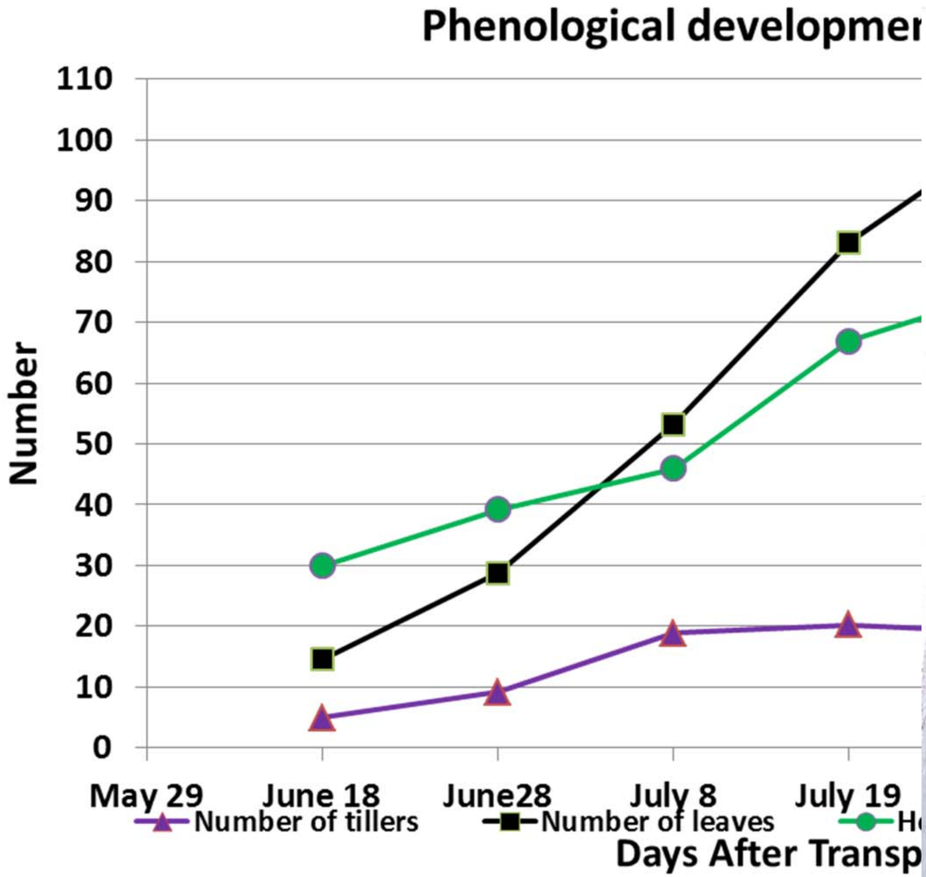
Source: M., Mizutani et al., (1999)

Results and discussion





Results and discussion



Profile of Paddy Layer under Ponding Condition