Agronomic and Environmental Impacts of Silicate Fertilizer Application on Rice Grown in Louisiana Soils

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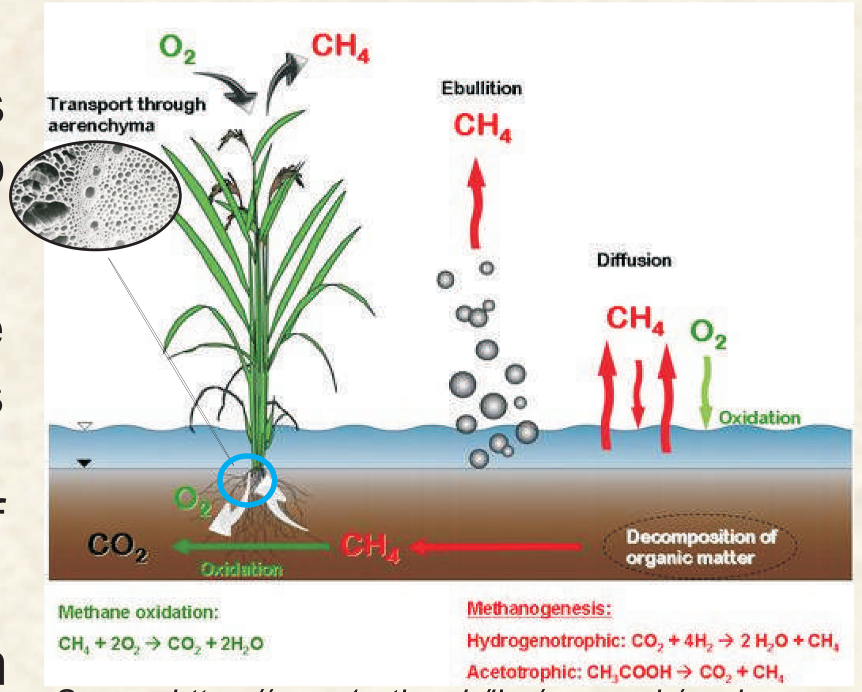
Introduction

- Irrigated lowland rice fields are major sources of atmospheric methane [CH_4] owing to anaerobic decomposition of organic matter.
- Mitigating CH_4 emissions from irrigated rice fields is very important to reduce its concentration in the atmosphere. Moreover, crop management could be a likely means of mitigating CH_4 emissions.
- Studies have shown that silicon (Si) can substantially increase tolerance of rice to abiotic and abiotic stresses. It also aids in the growth and nutrient uptake of Si-accumulating crops like rice and sugarcane.
- However, effects of applying Si-rice fertilizer on methane emission is still limited. Moreover, specific mechanisms responsible for the environmental benefits of Si application are not completely understood.



Source:https://www1.ethz.ch/ibp/research/environmentalmicrobiology/research/Wetlands

Objective

To elucidate the effect of varying sources of Si-rich materials on rice growth and CH_4 emission from rice field

Materials and Methods

- Pot experiment was conducted at LSU greenhouse from April to August 2012.
- Treatments:

A. Si source	B. Rate of application:
1) Carbonized rice hull (CRH)	1) 0 (control)
2) Carbonized sugarcane trash (CST)	2) 4 t/ha
3) Commercial calcium silicate (CCS)	3) 8 t/ha

- Soil type: 1) Perry clay; 2) Crowley silt loam Variety used: CL 261
- Methane emission was measured at maximum tillering, early panicle initiation, booting, flowering, and maturity.
- Gas samples were taken from open top chamber placed over the plant at 10, 20, and 30 minutes after covering the pot.
- Gas samples were analyzed using gas chromatography

1. Putting of base chamber
2. Covering the plant with upper chamber
3. Collecting gas samples
4. Transferring gas samples in a vial
5. Determining CH_4 content thru gas chromatography

Results and Discussion

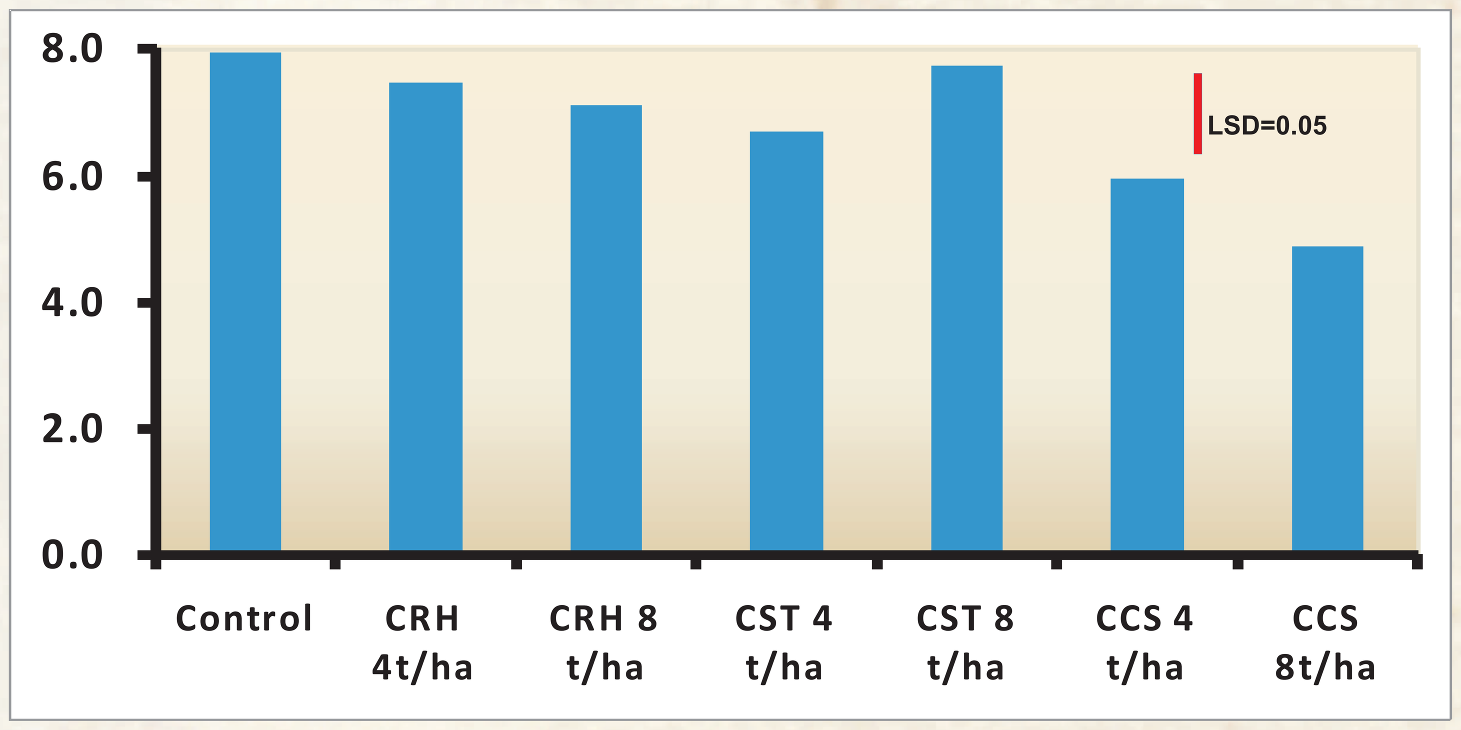


Fig. 1. Application of commercial calcium silicate slag significantly reduced methane emission by 17-22%. This could be attributed by the release of active iron oxide, a source of electron acceptor, eventually resulting in decreased CH_4 emission.

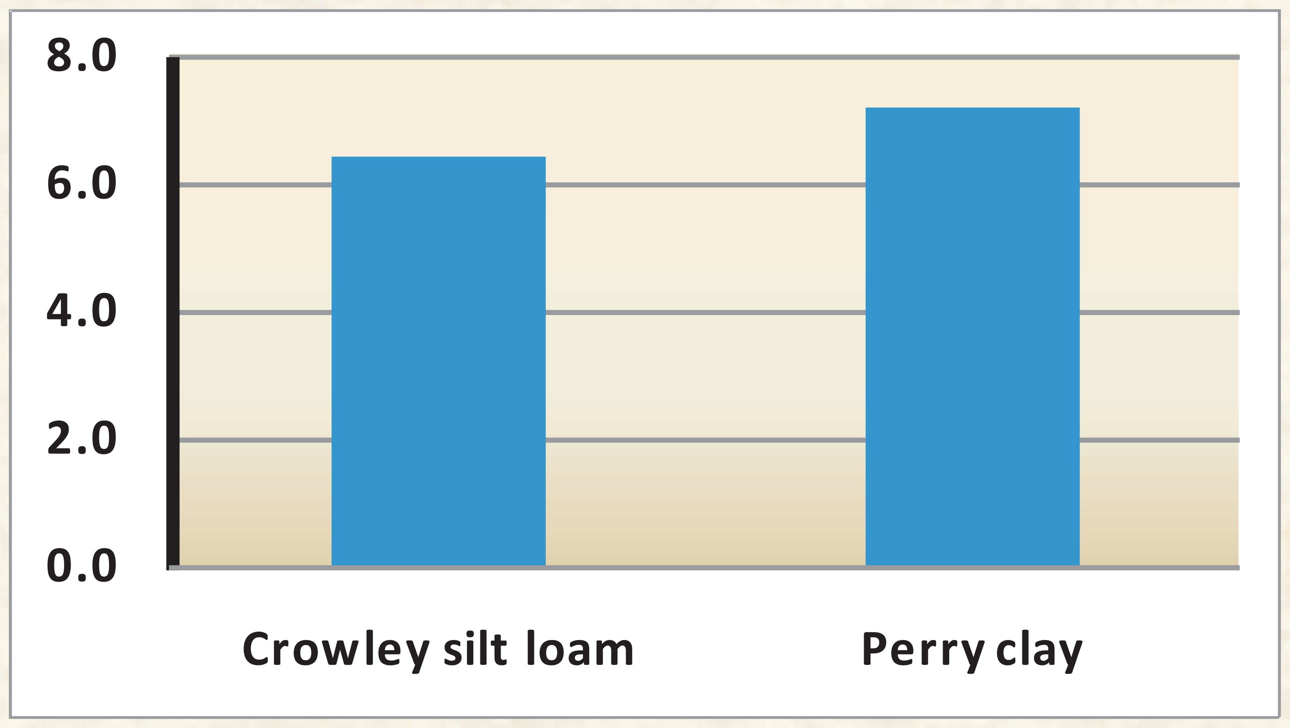


Fig. 2. CH_4 emission did not vary significantly between Perry clay and Crowley silt loam soil.

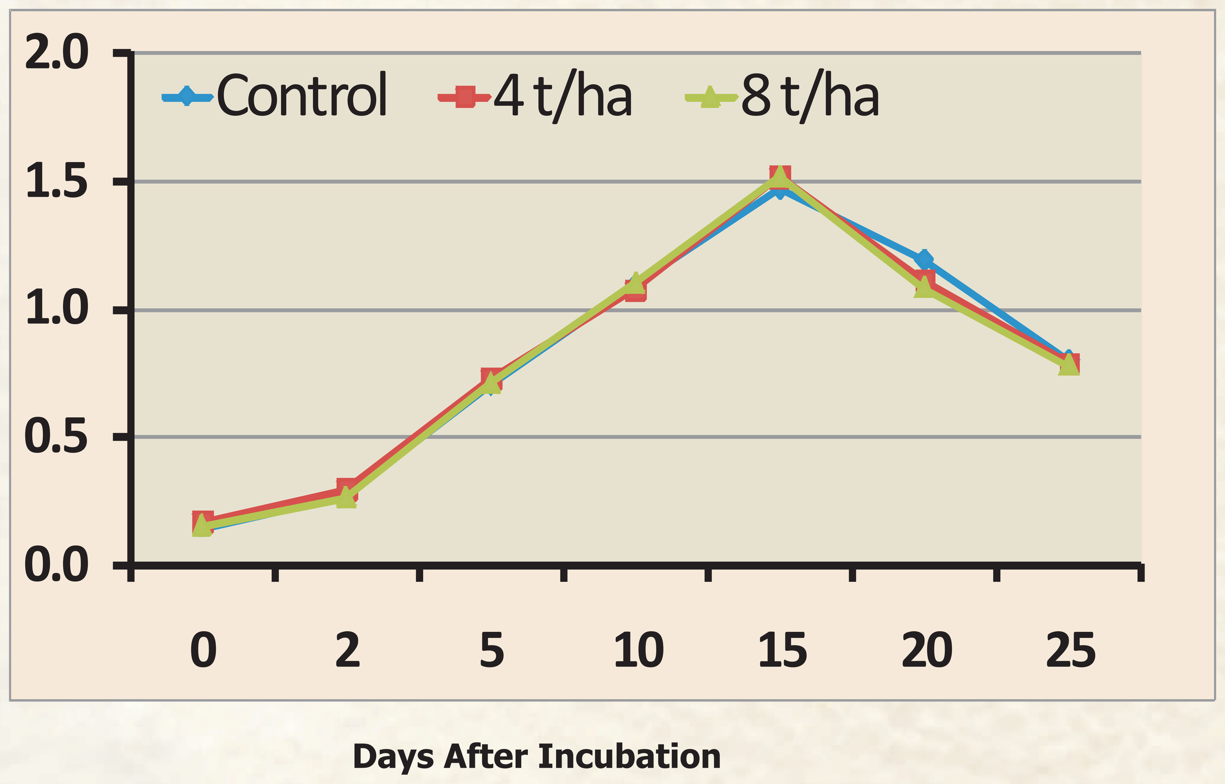


Fig.3. Application of CRH did not enhance CH_4 production potential of Crowley silt loam, indicating that CRH did not affect methanogenic and methanotrophic bacterial activities despite having high amount of carbon.

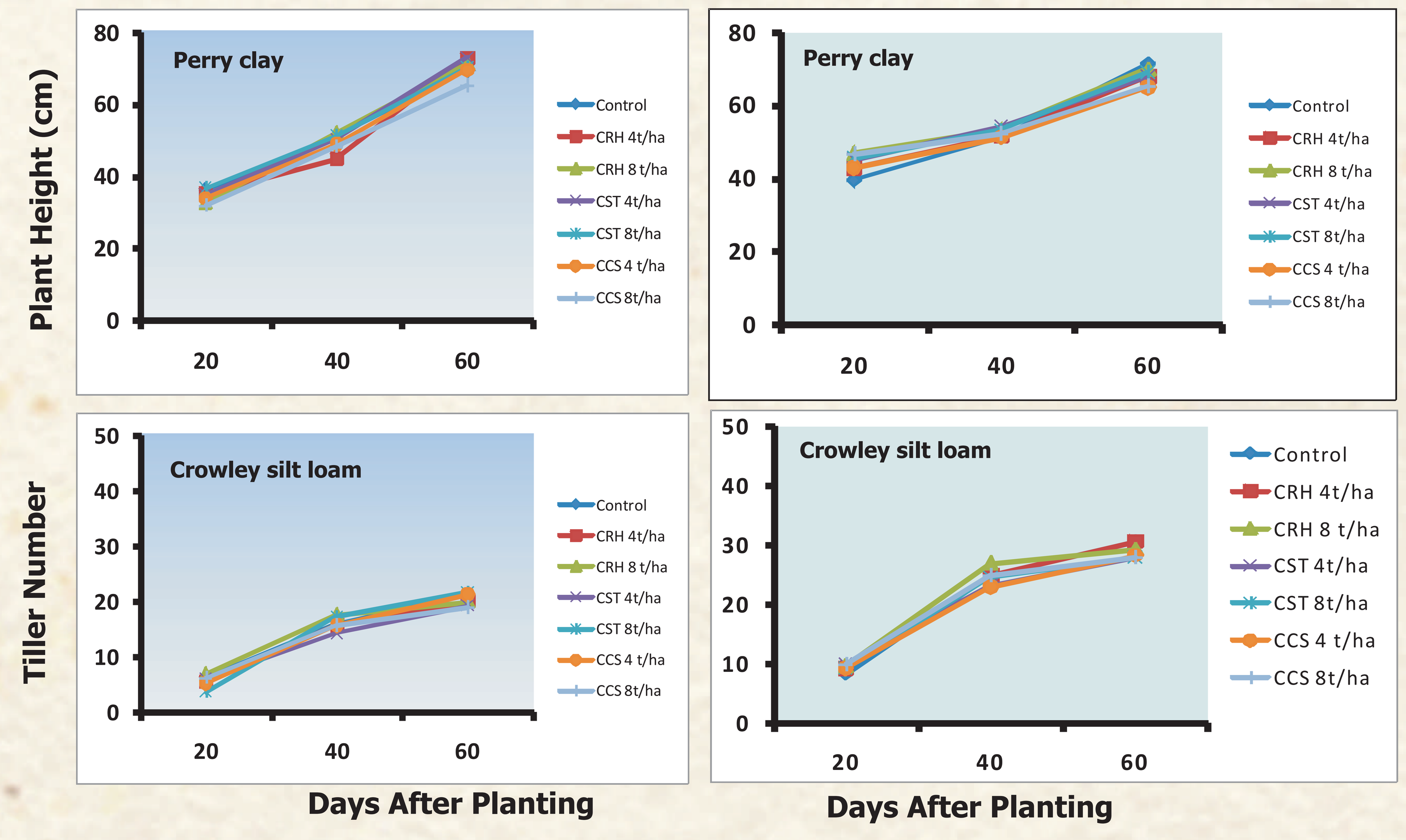


Fig. 4 Application of varying rates and sources of Si did not significantly increase tiller number and plant height of CL 261.

Conclusions and Recommendations

- Application of $CaSiO_3$ slag is a potential mitigation option for CH_4 emission from rice.
- Application of silicate fertilizer did not affect the growth of rice cv. CL 261. Moreover, CH_4 emission did not vary between Perry clay and Crowley silt loam soils.
- CRH application did not enhance CH_4 production potential under short-term incubation period.
- Research on the potential of these Si sources should be continued to understand their agronomic and environmental impacts especially in crop production systems requiring large supply of Si.

Acknowledgment

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