Introduction

• Arsenic contamination threatens rice production globally by lowering yield and poses a risk to human health due to grain accumulation of arsenic.
• Soil silicon additions can increase yield and decrease grain arsenic concentrations.1, 2
• While straw could be used for Si fertilization, its use in rice paddies is associated with increased methane emissions due to a high labile C content.3
• Rice husk, husk ash, and calcium silicate (CaSiO₃) are high in Si and low in C, making them suitable Si fertilizers.
• A pot experiment was conducted to test the effect of 3 silicon rich amendments on arsenic accumulation and greenhouse gas production.

Methods

3 silicon amendments:

- Rice Husk
- Rice Husk Ash
- Calcium Silicate

Soil spiked with arsenic (desired porewater concentration 300 µg/L)

3.5 kg Soil per pot

3 plants per pot (M206 variety)

Control Calcium Silicate Rice Husk Husk Ash

Rhizons installed to sample porewater

Weekly porewater sampling

Upon maturity, rice plants were harvested and digested for Si and As analysis

Flux measured weekly using custom-built chamber

Results

Porewater pH

![Graph showing porewater pH results](image)

- Ctrl
- CaSi
- Husk
- Ash

Week

Week

Figure 1. Weekly porewater pH measurements (pH ± SD) n = 4

Arsenic

![Graph showing Arsenic results](image)

- Ctrl
- CaSi
- Husk
- Ash

Week

Week

Figure 3. Porewater Arsenic analyzed by ICP-MS (µg L⁻¹ As ± SD) n = 4

Carbon Dioxide Flux

![Graph showing Carbon Dioxide Flux results](image)

- Ctrl
- CaSi
- Husk
- Ash

Week

Week

Figure 5. CO₂ flux (µmol m⁻² s⁻¹ CO₂ ± SD) n = 4. Cutoff for flux curve R² ≥ 0.9

Methane Flux

![Graph showing Methane Flux results](image)

- Ctrl
- CaSi
- Husk
- Ash

Week

Week

Figure 6. CH₄ flux (µmol m⁻² s⁻¹ CO₂ ± SD) n = 4. Cutoff for flux curve R² ≥ 0.9

Results (Plant Digestions)

- Control
- CaSiO₃
- Husk
- Ash

Figure 8. Average digestible silicon in straw and roots (g Si ± SD) n = 4

Figure 9. Average digestible straw arsenic (mg As ± SD) n = 4

Figure 10. Average grain digestible arsenic (mg/kg As ± SD) n = 4. Rice husk significantly decreases grain arsenic 40% relative to control. Average standard As recovery = 101%.

Grain As (concentration)

![Graph showing Grain As results](image)

Control CaSiO₃ Husk Ash

Grain As (mg/kg)

Conclusions

• Husk amendment increases grain yield and decreases grain arsenic concentration in comparison to other treatments
• Although calcium silicate increased straw silicon content, its effect on yield and grain As accumulation may limit its potential as a remediating agent/fertilizer
• Similar straw digestible As in husk and CaSiO₃ treatments may indicate As transport to grains is limited by husk treatment
• Husk may be an effective resource for lowering grain arsenic concentrations and increasing rice yield without increasing methane emissions

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References

