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Role of Silicon and Its Application Potential in Sustainable Agriculture via Rice Straw Recycling on Paddy Fields in the Mekong River Delta, Vietnam

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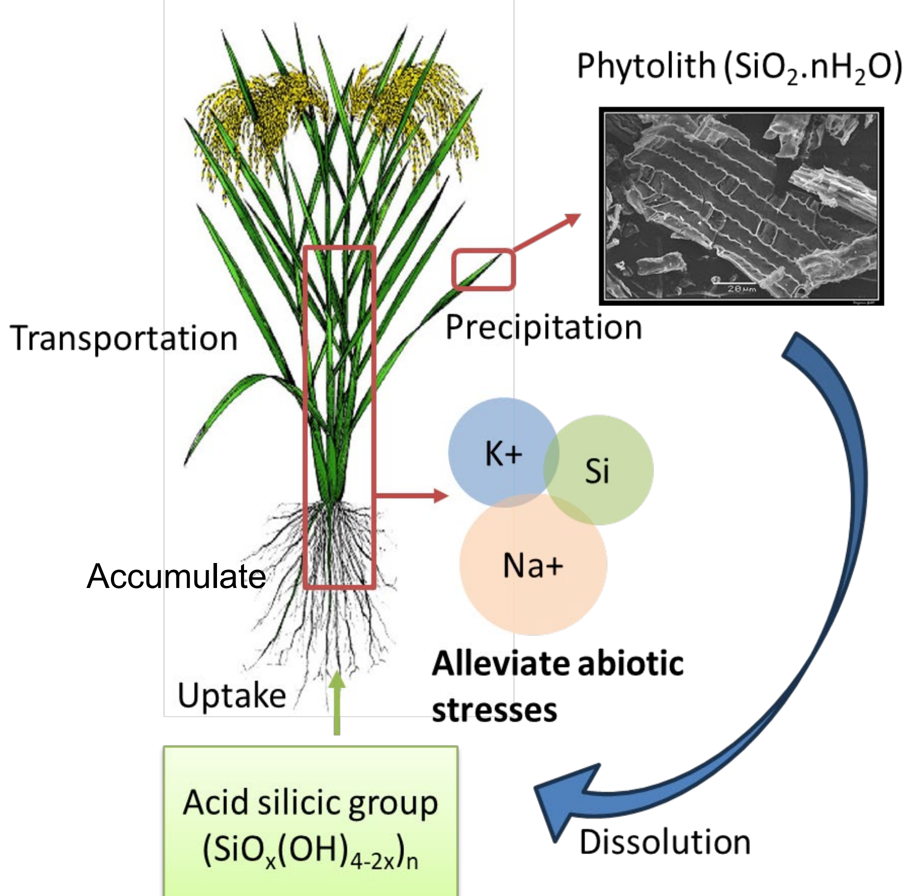
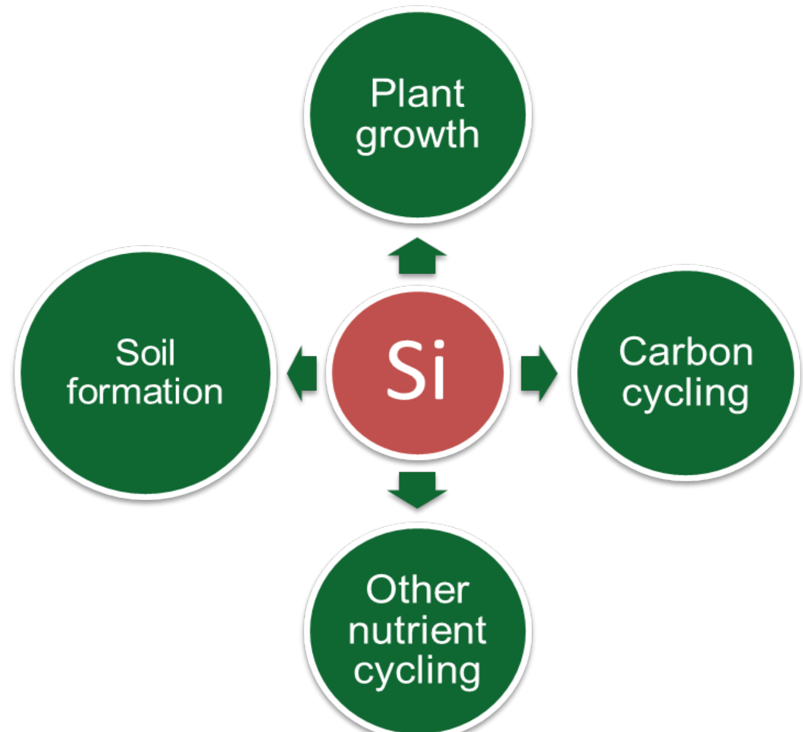
Over view

Silicon (Si) is the **<u>second most abundant element</u>** in the earth's crust and exists as silica (SiO_2) or silicates (combined with various metals) (Epstein, 1994; Sommer et al., 2006).

Si uptake by hyper-Si accumulator plant





(Schoelynck et al. 2014, Karz 2021, De Tombeur 1979).

Rice straw management

Nutrient contents in rice straw

N (%)	P (%)	K (%)	Si (%)	Refference
0.6	0.1	1.5	**5**	Ponnamperuma 1984
0.5-0.8	0.07-0.12	1.1-1.6	**4-7**	Dobermann and Fairhurst 2002

Open-field burning

Removal of rice straw after harvest for other purposes

Beneficial soil biota reduction

Greenhouse gas emissions

Nutrient imbalance in soil, especially Si

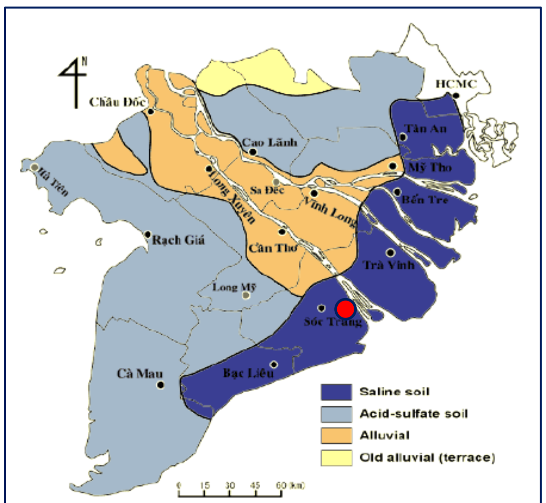
IRRI 2013

1. Lab-scale experiment

Rice straw, 3.3% Si

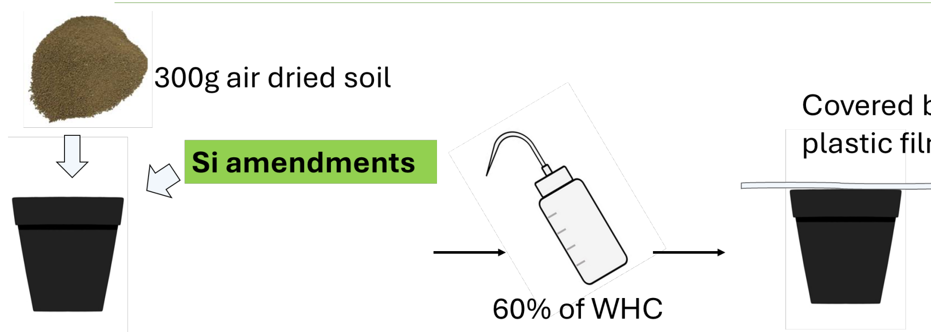
Rice straw ash, 10.4 % Si

Si fertilizer (iron ore tailing) 8.7 % Si



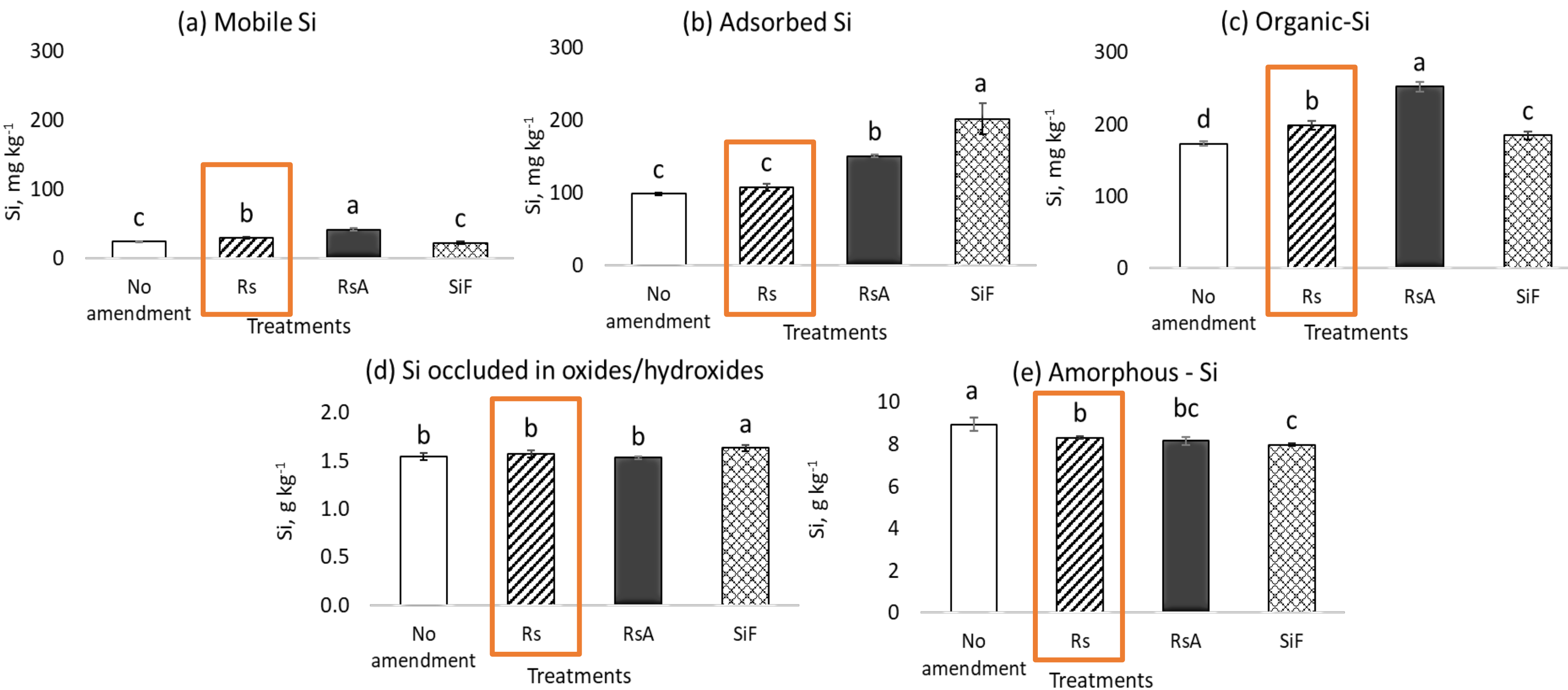
Lieu Tu – Mekong Delta, Vietnam
pH 6.9, available Si 93 mg/kg

Treatments	Description
No amendment	300 g Soil (No Si amendment application)
Rs	300 g Soil + Rice straw (2.1 g)
RsA	300 g Soil + Rice straw ash (0.66 g)
SiF	300 g Soil + Si fertilizer (0.79 g)



Biotron chamber 30°C in 30 days

Soil Si fractions after 30 days of incubation



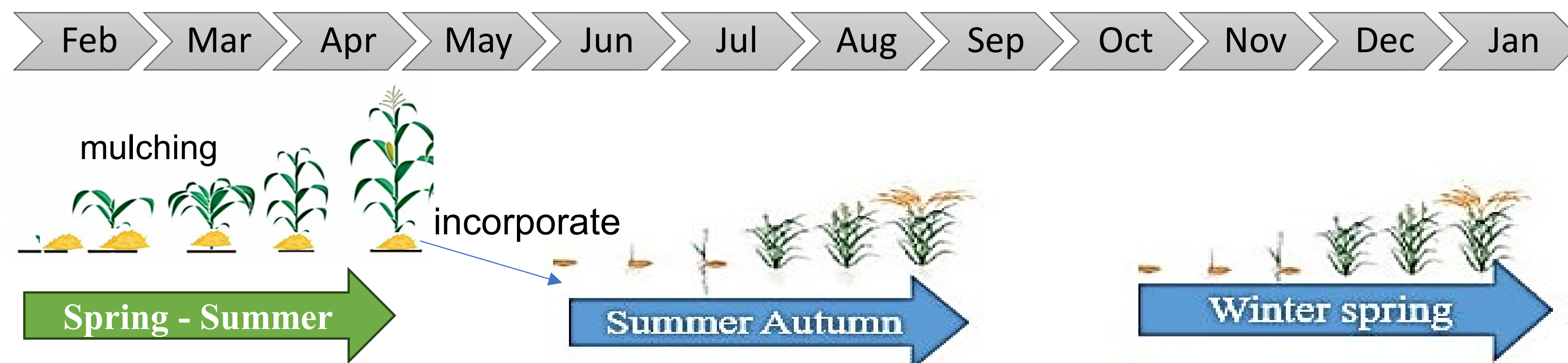
Soil Si fractions were extracted by sequential extraction method. Data values are means ± SD (n=4). Different letters indicate significant differences among treatments ($p<0.05$). Rs Rice straw, RsA Rice straw ash, SiF Si fertilizer

2. Field experiment

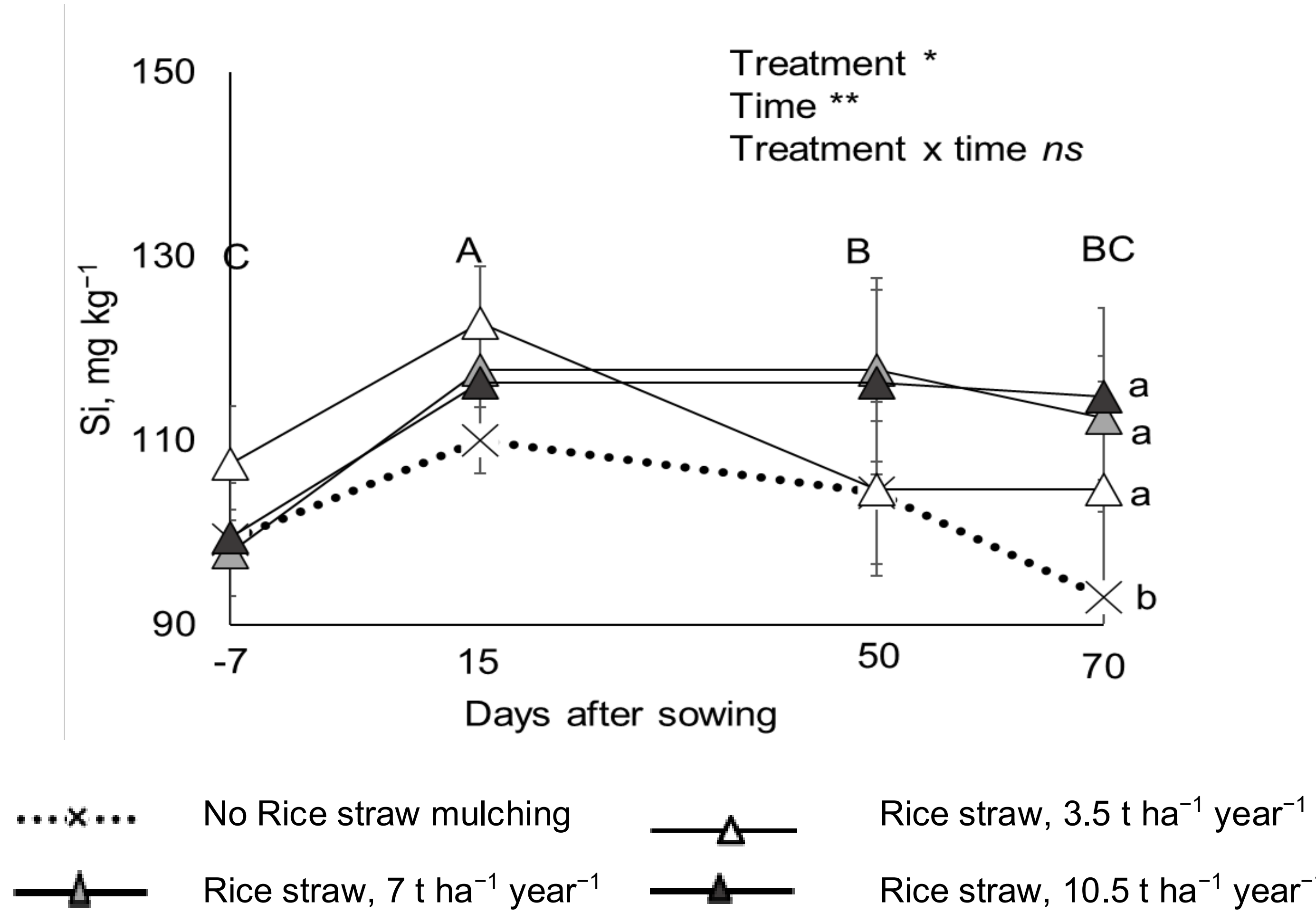
Location: Lieu Tu - Mekong Delta, Vietnam

Experiment design: randomized block design, 4 treatments x 3 replications, repeated in 3 years

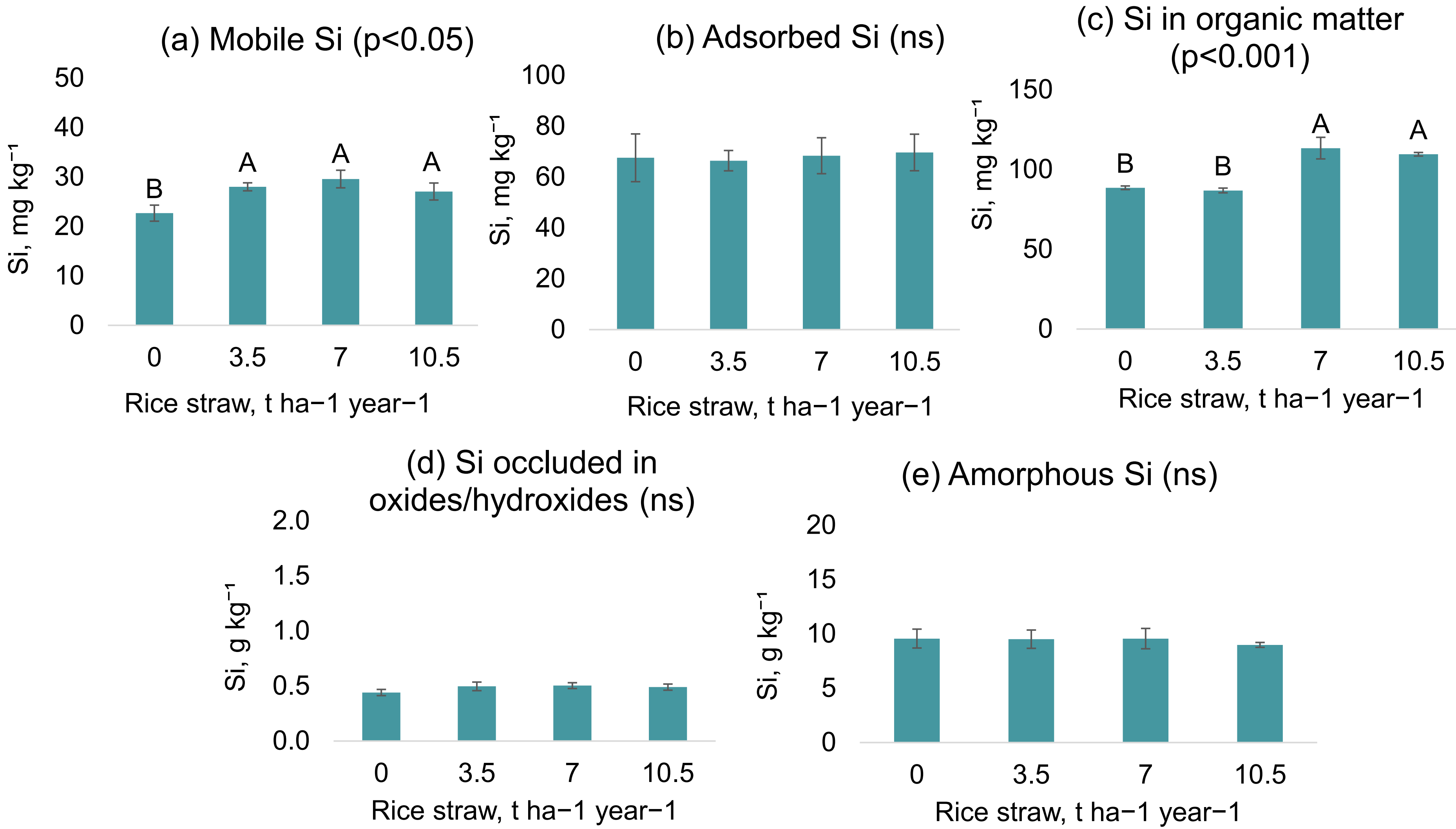
Treatment 1,2,3,4: Maize + Applied 0, 3.5, 7, 10.5 tons/ha/year of Rice straw (RS) mulching (dried weight), respectively.



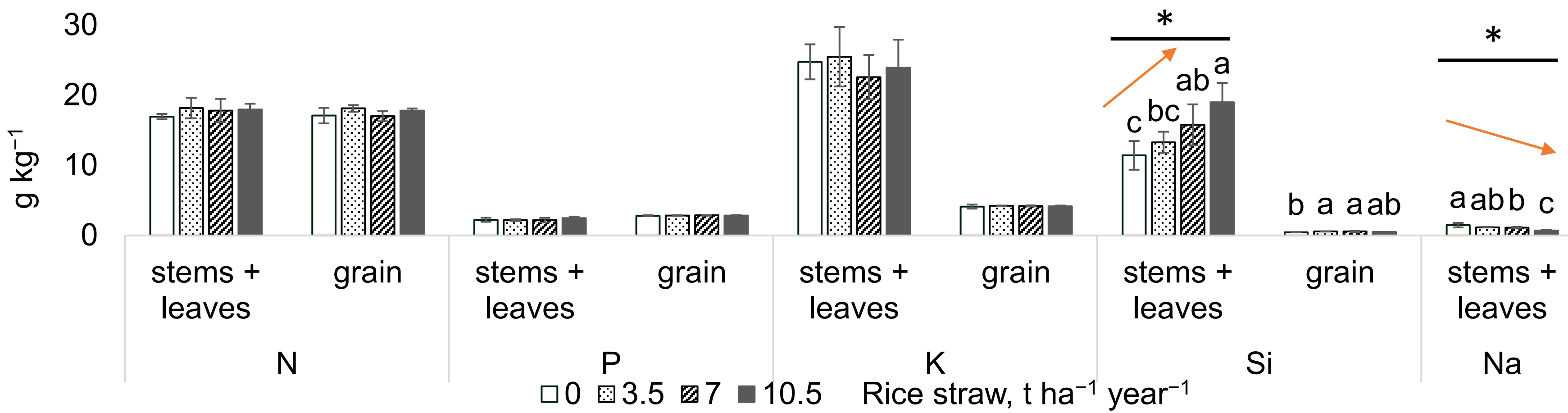
Changes in soil available Si (extracted by phosphate buffer) in the maize crop

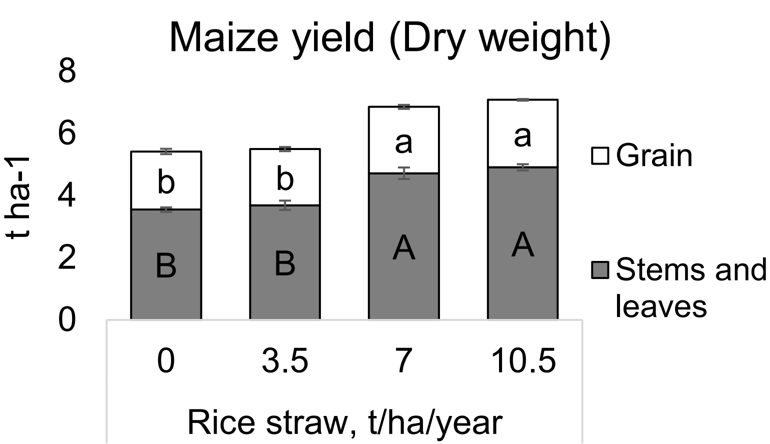


Soil Si fractions in 3rd maize crop (15DAS)

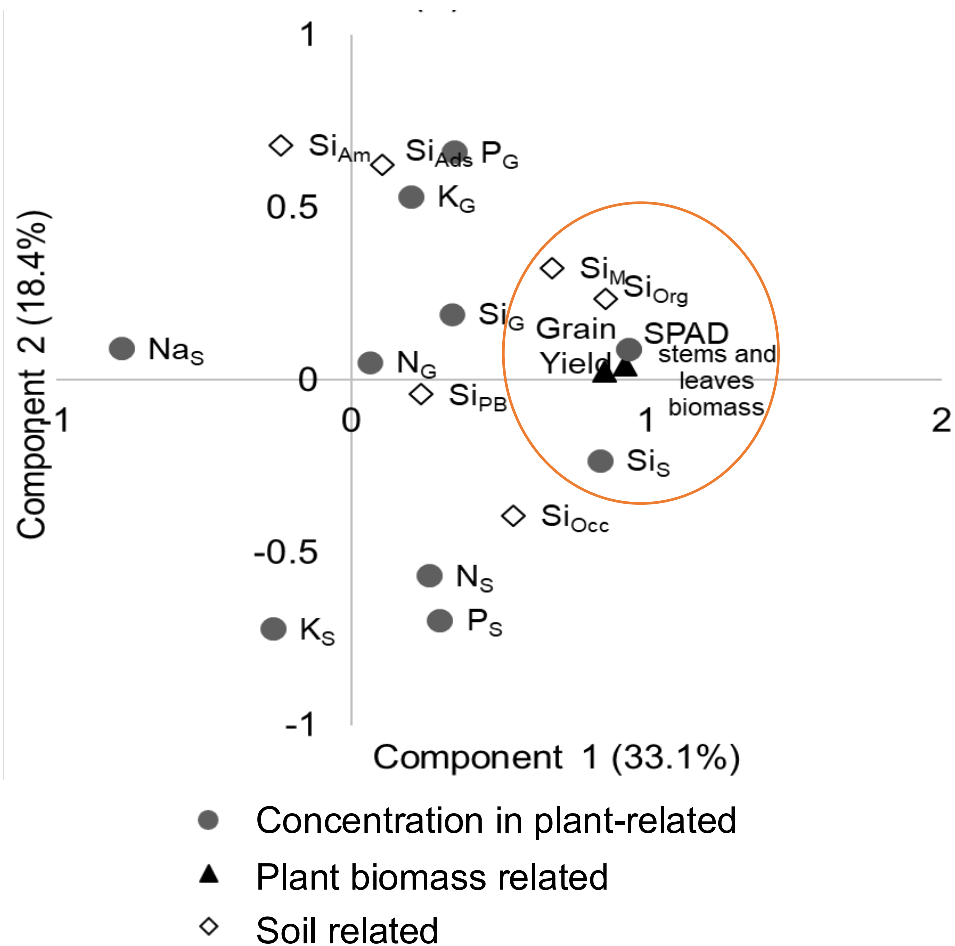


N, P, K, Si, Na content in maize plant and maize yield





Principal component plot



Principal component analysis of Si fractions in soil, N, P, K, Si and Na concentration in plant and maize yield and stems and leaves biomass. S stem and leaf, G grain.

CONCLUSION

- Rice straw mulch applied at levels of 7 and 10.5 t ha^{-1} $year^{-1}$ to maize crop increases soil Si availability, potentially contributing to improve maize growth under saline intrusion in the Mekong River Delta.
- Rice straw contributed not only plant-available Si (mobile Si) but also the reservoirs as organically bound Si and maintaining the Si amorphous pools.
- The negative correlation between Si and Na concentration in maize stem and leaf revealed the role of Si in mitigating Na toxicity in the maize plant

THANK YOU FOR KIND ATTENTION