Supplying silicon reduces Cadmium accumulation in pakchoi by decreasing soil Cd bioavailability and altering the microbial community

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Supplementary Information

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Table S1 Effects of silicon application on diversity and richness of soil bacterial communities.

Fig. S1 Effects of soil sodium silicate application on the biomass of pak choi (a) roots and (b) shoots..

Fig. S2 Effects of soil sodium silicate application on malondialdehyde (MDA; a) and H_2O_2 (b) concentration in pak choi tissues.

Fig. S3. Correlation analyses of pak choi biomass with Cd concentration in pak choi tissues and soil properties (a) Root and (b) Shoot.

Fig. S4 Beta diversity of rhizosphere soil bacterial community by NMDS analysis.

Fig. S5. Relationship among among microbial diversity (expressed by Shannon index (a) and Simpson index (b)) and richness (expressed by Ace index(c) by and Chao1 index (d)) with soil properties.

Text S1 Analytical methods of soil properties, and heavy metals in soil and plant tissues

(1) Basic physical and chemical of the tested soil

The basic physical and chemical of the field soil were analyzed based on the methods of Lu (2000). The soil pH value was measured using a pH electrode (PB-10; Sartorius, Germany) at a ratio of soil to water of 1:2.5. The soil organic matter (OM) was measured according to the Walkley-Black wet digestion method. The total nitrogen (TN) in the soil was measured using the Kjeldahl method, and Available nitrogen (AN) was determined using the alkaline hydrolysis method. Total soil phosphorus (TP) and available phosphorus (AP) was determined by the ascorbic acid-ammonium molybdenum method. Total soil potassium (TK) was digested with sodium hydroxide and analyzed by flame photometry. Available potassium (AK) was extracted with ammonium acetate and determined by flame photometry. The total concentration of Cd in the soil (0.2500 g) was digested in an electrothermal digester (DigiBlock ED54, LabTech, China) using 8 mL HNO_3 (guaranteed reagent) and 4 mL hydrofluoric acid (HF) (guaranteed reagent) at 120 ℃ for 1.0 h, and 150 ℃ for 2.0 h, respectively. The digestion process was complete when the digested solutions were 1-2 mL in volume. The digested solutions were then diluted to 50 ml with deionized water, filtered, and analyzed with ICP-MS (iCAP Q; Thermo Fisher Scientific, USA).

(2) Determination of Cd content in plant tissues

Fresh shoot and root samples (0.2500g) were digested with 8 mL of HNO_3 (guaranteed reagent) in an electrothermal digester (DigiBlock ED54, LabTech, China) at 80 ℃ for 1.5 h, 120 ℃ for 1.5 h, and 150 ℃ for 3.0 h, respectively. The digested solutions were then diluted to 50 ml with deionized water, filtered, and analyzed with ICP-MS. Additionally, for quality assurance purposes, blank samples and a certified reference material (SRM 1570a, Spinach leaves; National Institute of Standards and Technology, NIST) were incorporated. The recovery rate for SRM 1570a was 85–105%.

Table S1 Effects of silicon application on diversity and richness of soil bacterial communities

Treatments	Diversity index		Richness index		Coverage
	Shannon	Simpson	Ace	Chao1	
Si_{CK}	7.49±0.126 c	0.9838±0.003 b	1733±91 b	1690±92 b	0.9958±0.0002 a
$Si_{0.2}$	7.95±0.266 b	0.9860±0.004 ab	2125±182 a	1947±166 a	0.9945±0.0018 a
$Si_{0.4}$	8.13±0.240 ab	0.9873±0.003 ab	2194±97 a	2155±114 a	0.9949 ± 0.0004 a
$Si_{0.8}$	8.30±0.442 ab	0.9896±0.005 ab	2152±177 a	2128±189 a	0.9952±0.0003 a
$Si_{1.0}$	8.58±0.258 a	0.9923±0.002 a	2158±69 a	2146±75 a	0.9945±0.0000 a

Note: According to the LSD test, different letters indicate that a significant difference is detected ($p < 0.05$).

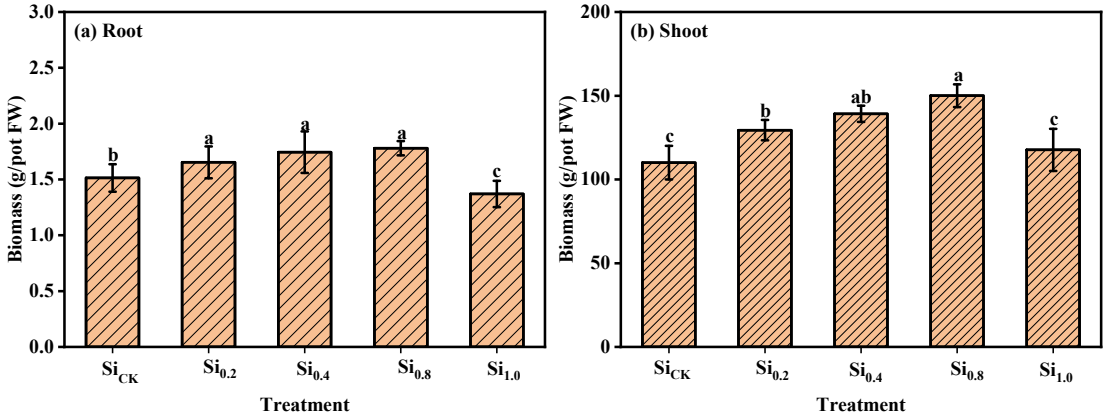

Fig. S1. Effects of soil sodium silicate application on the biomass of pak choi (a) roots and (b) shoots. Si_{CK}, $Si_{0.2}$, $Si_{0.4}$, $Si_{0.8}$, and $Si_{1.0}$ represent treatments where no sodium silicate was added, or sodium silicate was added at dosage of 0.20, 0.40, 0.80, and 1.00 g Si /kg soil, respectively. The data are presented as means ± SD (n=4). According to the LSD test, different letters in the figure indicate significant differences according to the LSD test ($p < 0.05$).

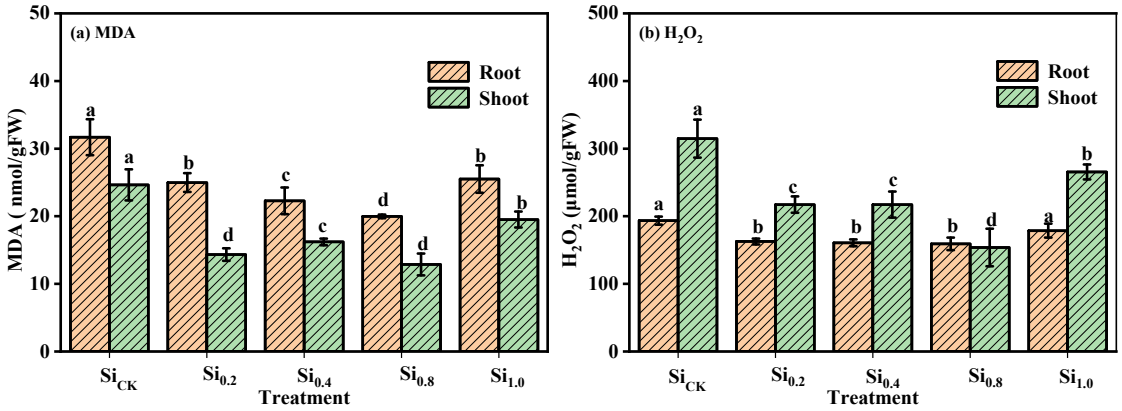

Fig. S2. Effects of soil sodium silicate application on malondialdehyde (MDA; a) and H_2O_2 (b) concentration in pak choi tissues. Si_{CK}, $Si_{0.2}$, $Si_{0.4}$, $Si_{0.8}$, and $Si_{1.0}$ represent treatments where no sodium silicate was added, or sodium silicate was added at dosage of 0.20, 0.40, 0.80, and 1.00 g Si /kg soil, respectively. The data are presented as means ± SD (n=4). According to the LSD test, different letters in the figure indicate significant differences according to the LSD test ($p < 0.05$).

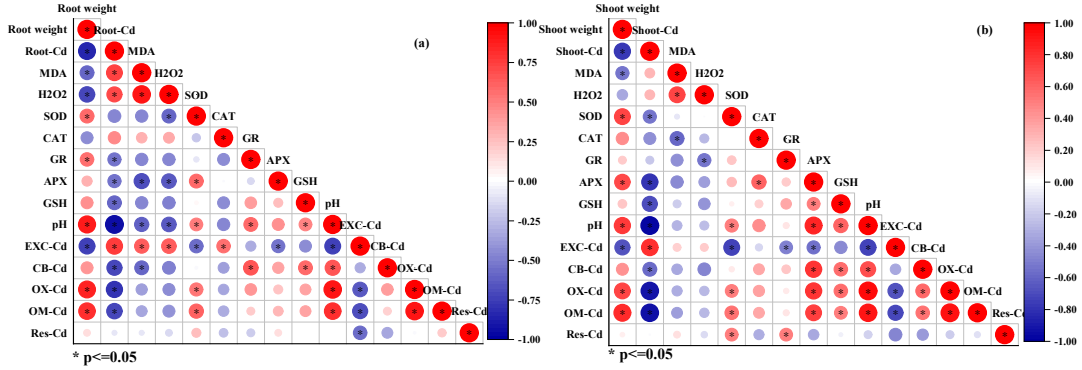

Fig. S3. Correlation analyses of pak choi biomass with Cd concentration in pak choi tissues and soil properties (a) Root and (b) Shoot.

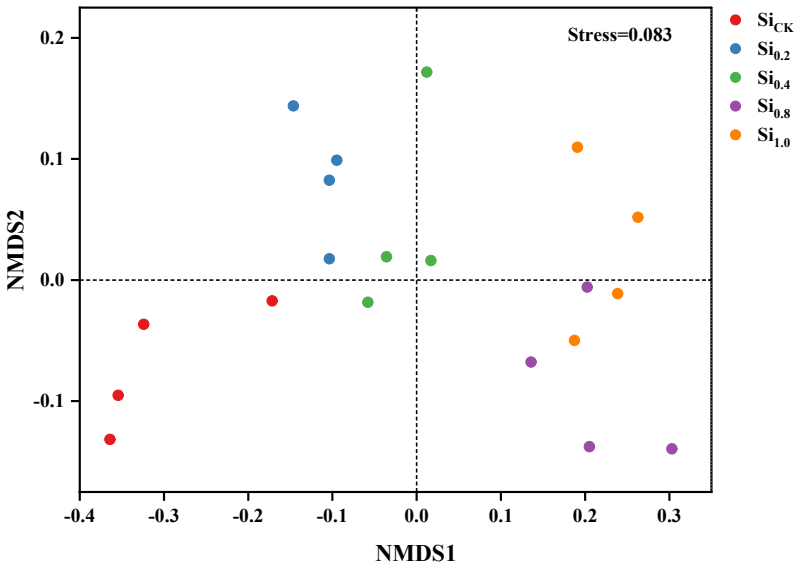

Fig. S4. Beta diversity of rhizosphere soil bacterial community by NMDS analysis. Si_{CK}, $Si_{0.2}$, $Si_{0.4}$, $Si_{0.8}$, and $Si_{1.0}$ represent treatments where no sodium silicate was added, or sodium silicate was added at dosage of 0.20, 0.40, 0.80, and 1.00 g Si /kg soil, respectively.

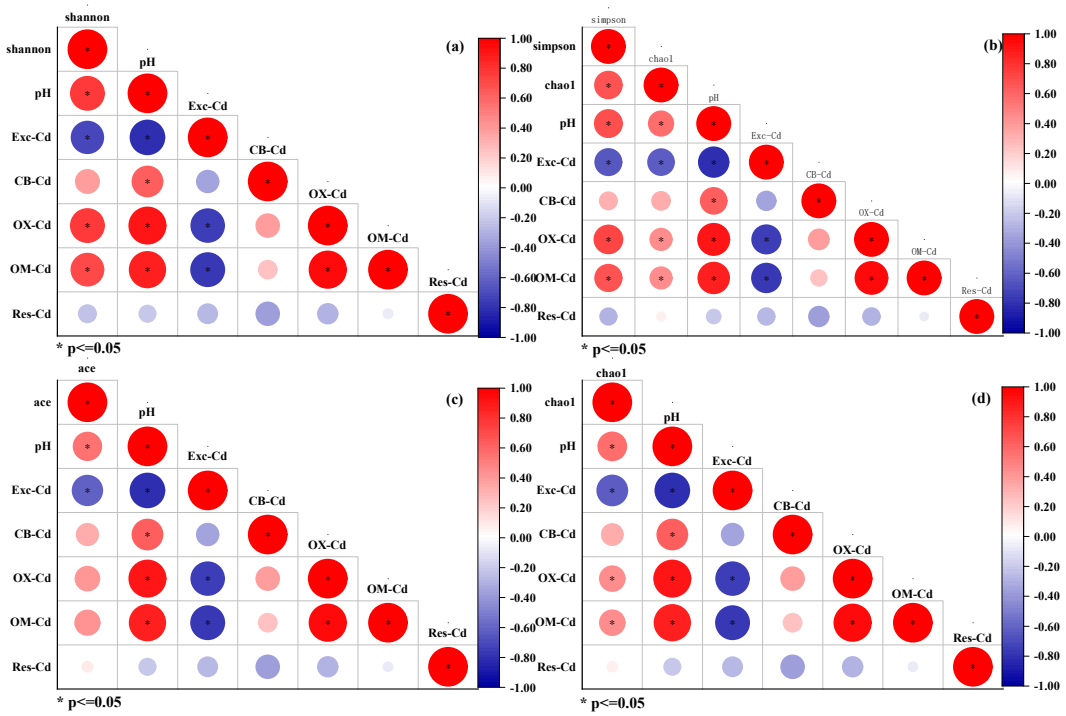

Fig. S5. Relationship among among microbial diversity (expressed by Shannon index (a) and Simpson index (b)) and richness (expressed by Ace index(c) by and Chao1 index (d)) with soil properties.