Supplementary Information (SI) for Environmental Science: Nano.

Silica nanoparticles enhance plant disease resistance by modulating the endophyte community structure in tomato (*Solanum lycopersicum* L.) roots

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Supplemental Information (SI)

Experiment S1: Determination of soil physical and chemical properties

Soil samples were collected at plant harvest, air-dried, and passed through a 2 mm sieve. The soil was then stored for future analysis. Soil pH and electrical conductivity (EC) were measured using a conductivity/pH meter (Fisher Scientific, XL200) after shaking a soil suspension (water: soil = 2.5:1 [v/w]) at 250 rpm for 5 min. Total nitrogen in the soil was analyzed using an automated TOC analyzer (Vario TOC, Elementar, Langenselbold, Germany). Soil organic matter was determined by the $K_2Cr_2O_7$-H_2SO_4 solution and $FeSO_4$ titration method.[1] Available P was detected using the Bray-1 method.[2] Available K was determined by a flame photometer method.[1] The $CaCl_2$-Si (extracted by 0.01 mol·L^{-1} $CaCl_2$ solution) and total silicon content (extracted by 0.025 mol·L^{-1} citric acid solution) in the soil was determined according to Ning (2022).[3] Soil urease, sucrase, and acid phosphatase activity were determined using the indophenol colorimetric method, 3,5-dinitrosalicylic acid colorimetric method, and p-nitrophenyl phosphate colorimetric method, respectively, according to Guan et al. (1986).[4]

Reference:

1 S. D. Bao, Soil and Agricultural Chemistry Analysis, Chinese Agricultural Publishing House, Beijing, China, 2005.

2 R. H. Bray, L. T. Kurtz, Determination of total, organic, and available forms of phosphorus in soils. *Soil science*, 1945, **59**, 39-46.

3 C. Ning, L. Wang; R. Liu; T. Pan, Y. Cai, J. Tian, S. Luo, K. Cai. Plant-mediated rhizospheric interactions in rice and water spinach intercropping enhance Si uptake by rice. *Plant Soil*, 2022, **477**, 183-199.

4 Guan, S. Y.; Zhang, D.; Zhang, Z. Soil enzyme and its research methods. Agricultural, Beijing, 1986, **1986**, 274-297.

Supplemental figures and tables

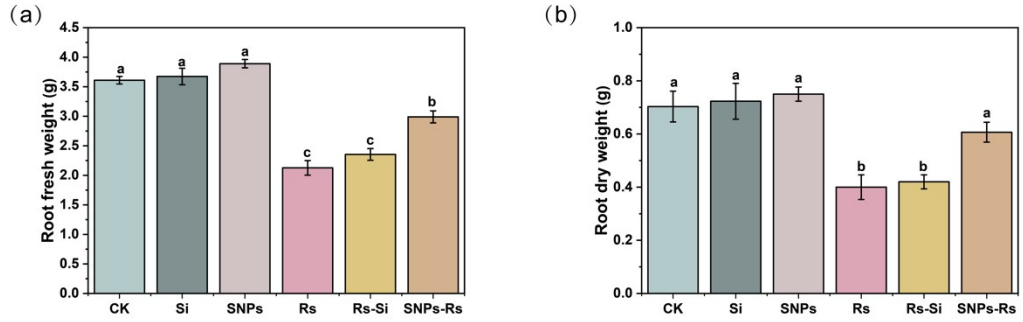

Figure S1. The effect of SNPs application on plant growth under *R. solanacearum* infection. Root a) fresh weight and b) dry weight. Statistical comparisons were performed by one-way ANOVA with a Duncan's test (two-tailed). Different letters indicate statistically significant differences at $p<0.05$. Error bars indicate standard errors (n≥3). CK, Control; Si: Root exposure to 130 mg·L^{-1} Si ion; SNPs, Root exposure to 650 mg·L^{-1} SNPs; Rs, *R. solanacearum* inoculated control; Si-Rs, *R. solanacearum* inoculated and Root exposure to 130 mg·L^{-1} Si ion; SNPs-Rs, *R. solanacearum* inoculated and root exposure to 650 mg·L^{-1} SNPs.

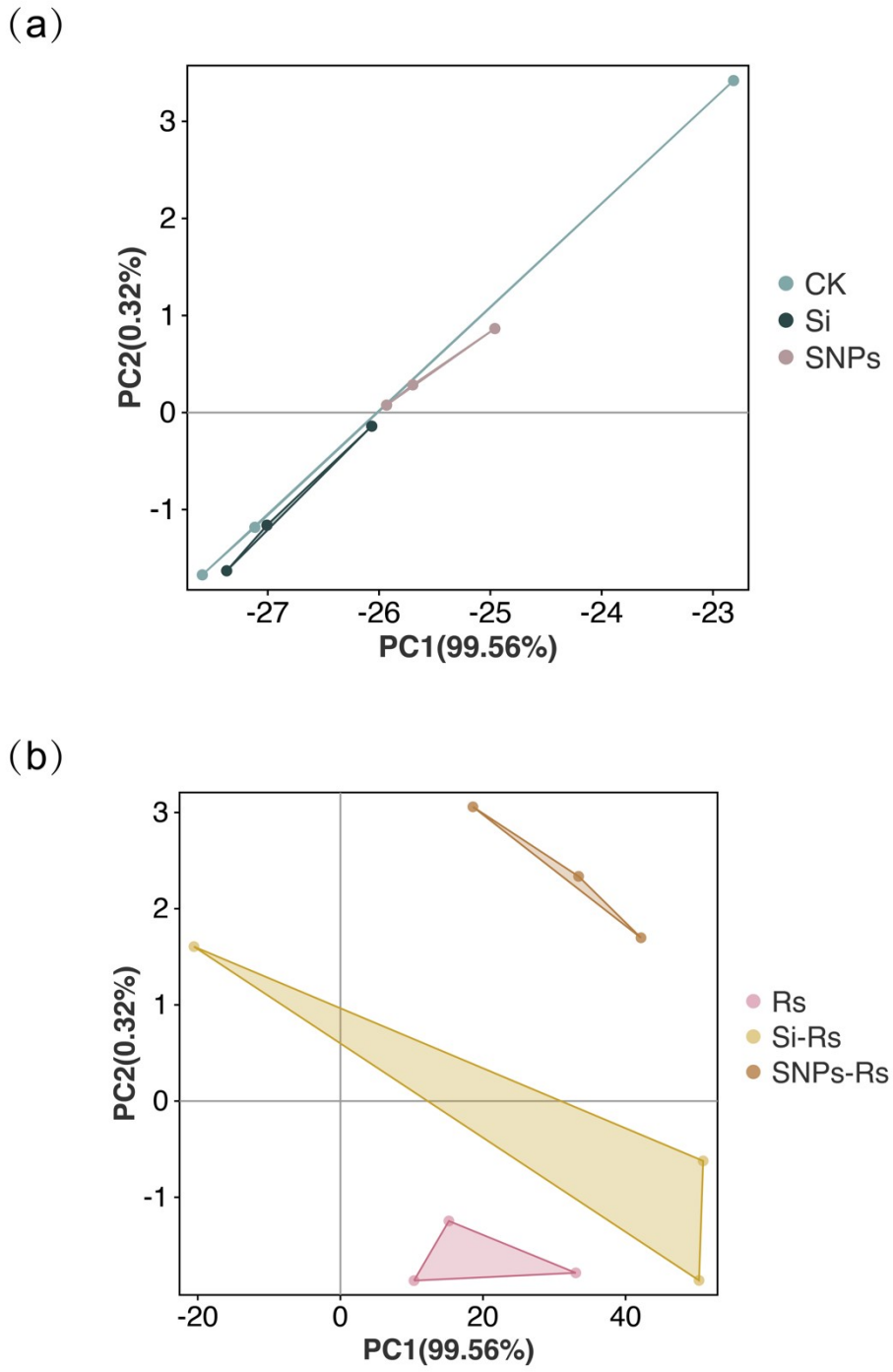

Figure S2. The PCA analysis of tomato endophytic bacterial communities in a) Healthy group; b) Diseased group.

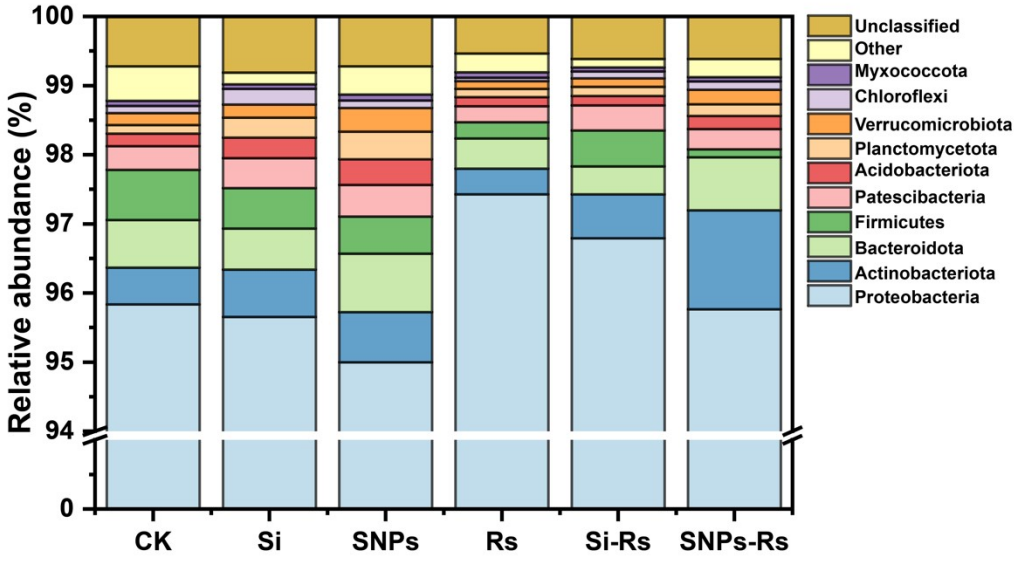

Figure S3. The endophytic bacterial change of community structure for the top 10 phyla.

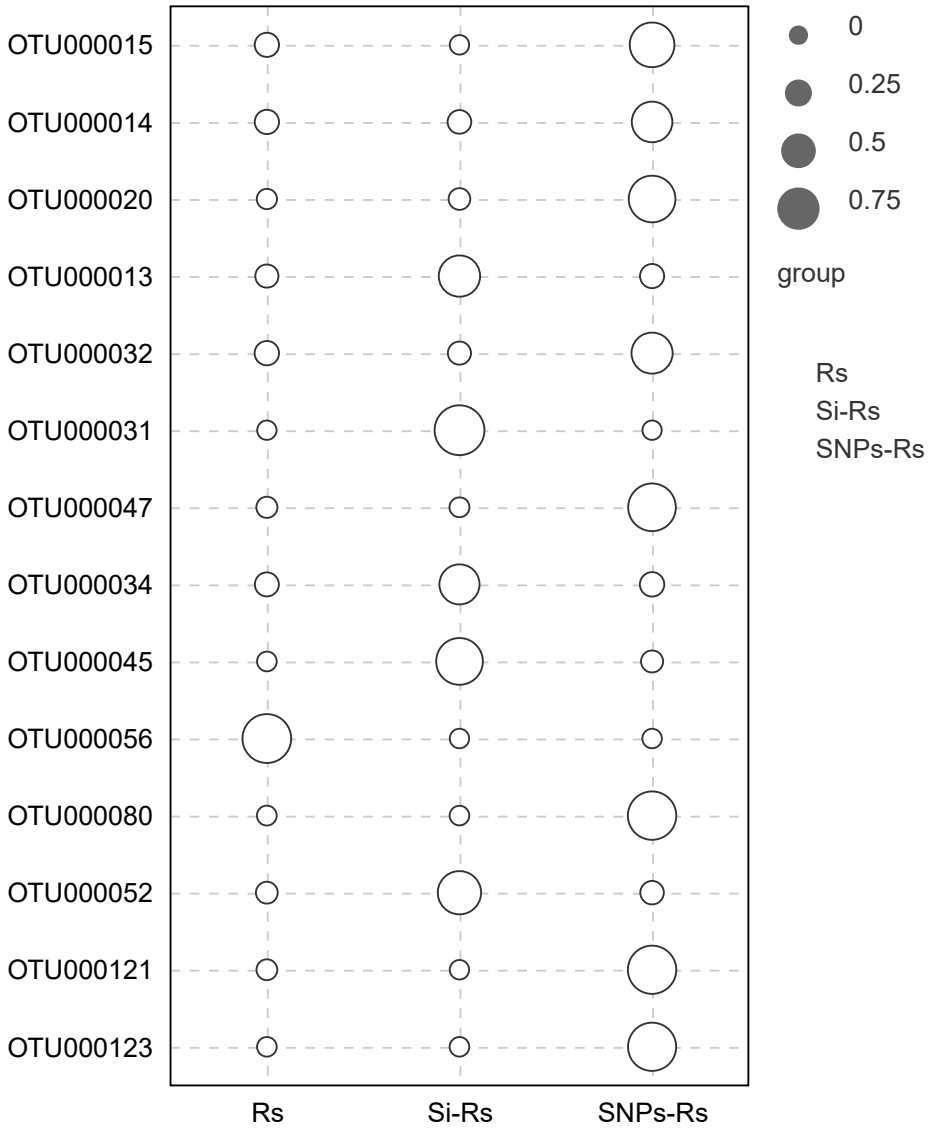

Figure S4. The indicator analysis of root endophytic bacterial communities in the diseased group at OTUs levels. Rs, *R. solanacearum* inoculated control; Si-Rs, *R. solanacearum* inoculated and Root exposure to 130 mg·L^{-1} Si ions; SNPs-Rs, *R. solanacearum* inoculated and root exposure to 650 mg·L^{-1} SNPs. $p < 0.05$. Only species with indicator values >0.6 were seen as indicator species.

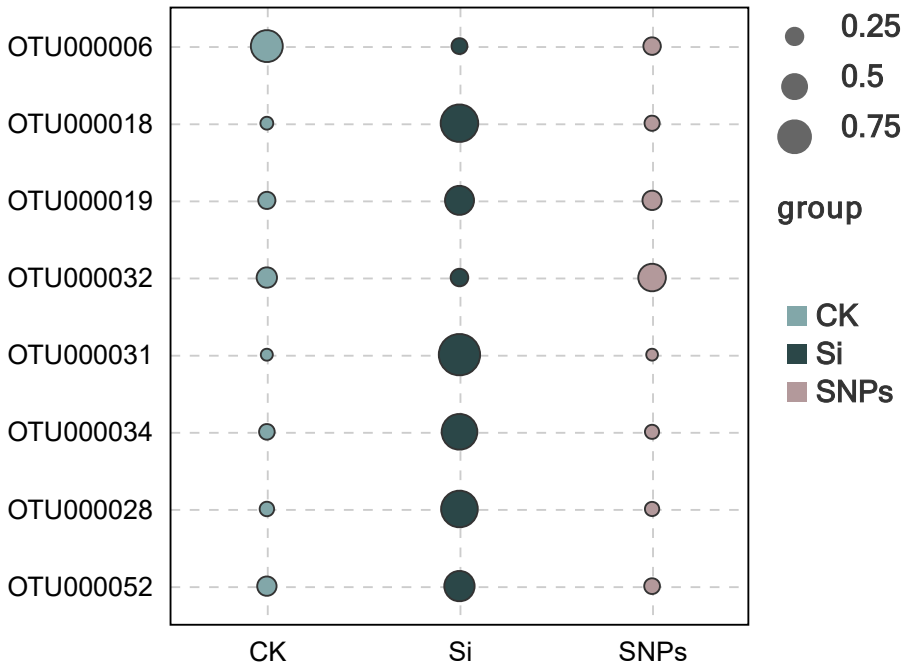

Figure S5. The indicator analysis of root endophytic bacterial communities in the healthy group at OTUs levels. CK, Control; Si: Root exposure to 130 mg·L^{-1} Si ions; SNPs, Root exposure to 650 mg·L^{-1} SNPs. $p < 0.05$. Only species with indicator values >0.6 were seen as indicator species.

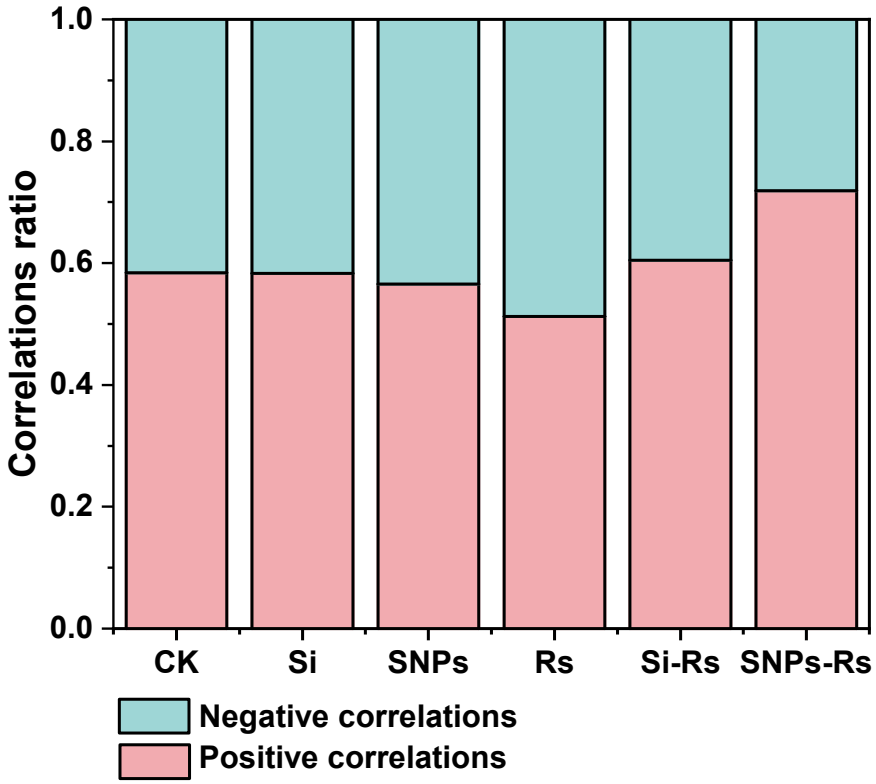

Figure S6. The positive/negative correlation ratio at the phylum level.

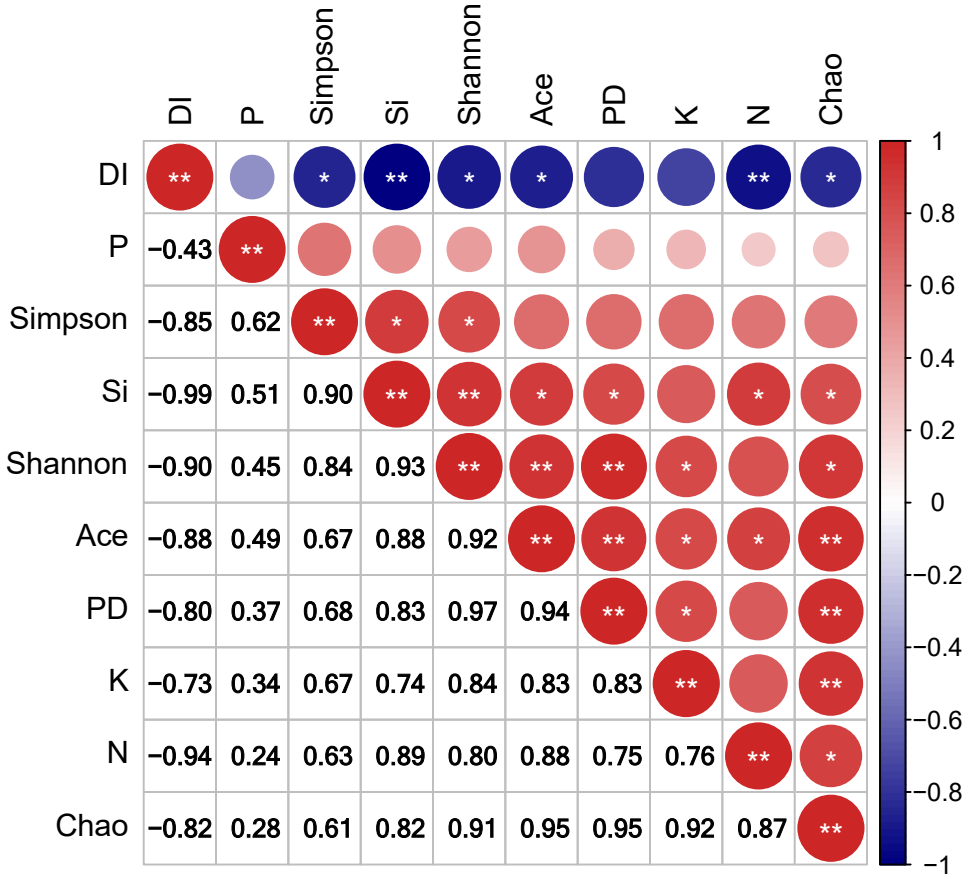

Figure S7. The correlation analysis of endophytic bacterial diversity and nutrient content in roots. DI: Disease index; K: potassium; N: Nitrogen; Si: Silicon; P: P_2O_5. The diversity index includes Chao, Ace, PD, and Shannon. *, ** Significant correlations at $p< 0.05$ and < 0.01, respectively.

Table S1 The properties of co-occurring bacterial networks in root endophytes obtained from different treatments and their corresponding random networks

	CK	Si	SNPs	Rs	Si-Rs	SNPs-Rs
Empirical networks						
Number of nodes	105	110	111	63	78	100
Number of edges	1544	1575	1580	394	1002	1716
Number of positive correlations	902	918	899	202	606	1234
Number of negative correlations	642	657	691	192	396	482
Graph Density	0.283	0.263	0.259	0.202	0.334	0.347
Average clustering coefficient (avgCC)	1	0.993	1	1	1	0.987
Average degree (avgK)	29.41	28.636	28.468	12.508	25.692	34.32
Modularity (M)	0.597	0.573	0.624	0.706	0.636	0.425
Random networks[b]						
APL ± SD	1.711±0.000	1.736±0.000	1.742±0.000	1.860±0.007	1.748±0.001	1.653±0.000
avgCC ± SD	0.288±0.003	0.263±0.003	0.259±0.003	0.201±0.010	0.253±0.004	0.346±0.003
M ± SD	0.112±0.005	0.119±0.004	0.120±0.003	0.194±0.010	0.131±0.005	0.098±0.004