

Table S1. Group-specific Mantel correlations between bacterial community composition and soil physicochemical variables across the three elevation groups.

Soil variable	LF Mantel r	MF Mantel r	HF Mantel r
DOC/SOC*	0.111	0.329	0.496
AN	0.230	0.348	0.394
AK	0.165	0.263	0.253
AP	0.031	0.372	0.173
TK	0.027	0.318	0.058
TP	0.260	0.390	0.146
TN	0.109	0.244	0.476
pH	0.171	0.043	0.393

Mantel correlations are presented as exploratory within-group associations and are not used to compare the strength of environment–community coupling among elevation groups.

Table S2. Site-level relative abundance (%) of OTUs assigned to the SILVA *Allorhizobium–Neorhizobium–Pararhizobium–Rhizobium* group across the 15 field sites

OTU ID	SILVA species annotation	n/13 5	Contributi on (%)	LHL LF	LGF LF	MBF LF	HLF LF	FHF LF	MXF MF	LQF MF	HZF MF	HWF MF	MSQ MF	SAF HF	SBF HF	TAF HF	TBF HF	GFR HF
OTU214 44	<i>Rhizobium phaseoli</i>	135	90.1913	0.487 0	0.248 2	0.449 2	6.331 8	9.101 3	1.805 0	9.3695	0.490 3	0.315 3	0.510 1	20.487 1	21.823 0	4.080 1	0.237 0	1.049 7

OTU ID	SILVA species annotation	n/13 5	Contributi on (%)	LHL LF	LGF LF	MBF LF	HLF LF	FHF LF	MXF MF	LQF MF	HZF MF	HWF MF	MSQ MF	SAF HF	SBF HF	TAF HF	TBF HF	GFR HF
OTU141 94	<i>Agrobacteri um radiobacter</i>	135	7.0912	0.650 9	0.361 4	0.484 3	0.299 9	0.331 3	0.323 2	1.0409	0.272 5	0.223 2	0.184 2	0.8010	0.8030	0.158 1	0.051 9	0.051 2
OTU145 33	Unclassified within target group	131	1.7055	0.023 7	0.008 8	0.009 1	0.017 0	0.089 2	0.248 2	0.4370	0.071 2	0.045 1	0.009 2	0.2968	0.0398	0.130 9	0.011 9	0.014 1
OTU226 14	Unclassified within target group	107	0.4397	0.143 7	0.013 2	0.018 7	0.013 2	0.002 5	0.014 6	0.0404	0.010 9	0.005 5	0.037 2	0.0159	0.0560	0.000 6	0.001 3	0.000 6
OTU178 21	<i>Pararhizobi um giardinii</i>	132	0.3261	0.022 7	0.012 8	0.021 5	0.008 4	0.013 1	0.016 1	0.0280	0.018 9	0.011 8	0.022 1	0.0346	0.0268	0.023 4	0.002 7	0.014 8
OTU206 29	Unclassified within target group	119	0.2306	0.031 9	0.008 1	0.026 4	0.010 5	0.032 2	0.005 4	0.0104	0.009 2	0.022 0	0.021 9	0.0003	0.0023	0.007 9	0.004 8	0.002 9
OTU248 73	Unclassified within target group	21	0.0087	0	0	0	0.000 9	0.000 9	0	0.0013	0	0	0	0.0012	0.0024	0.000 6	0	0
OTU210 03	Unclassified within target group	12	0.0040	0.000 1	0	0	0.001 8	0.000 9	0.000 3	0.0001	0.000 2	0	0	0	0	0	0	0

OTU ID	SILVA species annotation	n/13 5	Contributi on (%)	LHL LF	LGF LF	MBF LF	HLF LF	FHF LF	MXF MF	LQF MF	HZF MF	HWF MF	MSQ MF	SAF HF	SBF HF	TAF HF	TBF HF	GFR HF
OTU242 56	Unclassified within target group	8	0.0024	0	0	0	0	0	0	0.0001	0	0	0	0.0005	0.0015	0	0	0
OTU118 16	<i>Rhizobium</i> sp. Y21	1	0.0003	0	0.000 2	0	0	0	0	0	0	0	0	0	0	0	0	0
OTU118 85	<i>Rhizobium</i> sp. Y21	1	0.0003	0	0.000 2	0	0	0	0	0	0	0	0	0	0	0	0	0
Total target group	—	—	100.0000	1.360 1	0.653 0	1.009 2	6.683 5	9.571 4	2.412 8	10.927 7	0.873 1	0.622 8	0.784 7	21.637 4	22.754 8	4.401 8	0.309 5	1.133 3