Table S1. qPCR primers and conditions.

Primer name	Primer sequence (5'-3')	Target gene	Thermal profile	Reference
R3cd	GASTTCGGRTGSGTCTTGA	Bacterial *nirS* gene	95°C, 3.0min; 40×(95°C, 10s; 58°C, 30s; 72°C, 30s, 80°C, 5s with plate read); Melt curve 75.0°C to 95.0°C, increment 0.5°C, 0:05s + plate read	Throbäck et al., 2004
cd3aF	GTSAACGTSAAGGARACSGG			
nosZ-F	CGYTGTTCMTCGACAGCCAG	Bacterial *nosZ* gene	95°C, 3.0min; 40×(95°C, 10s; 62°C, 30s; 72°C, 30s, 80°C, 5s with plate read); Melt curve 75.0°C to 95.0°C, increment 0.5°C, 0:05s + plate read	Throbäck et al., 2004
nosZ1622R	CGCRASGGCAASAAGGTSCG			
amoA-F	STAATGGTCTGGCTTAGACG	AOA *amoA* gene	95°C, 3.0min; 40×(95°C, 20s; 55°C, 30s; 72°C, 30s with plate read); Melt curve 65.0°C to 95.0°C, increment 0.5°C, 0:05s + plate read	Francis et al., 2005
amoA-R	GCGGCCATCCATCTGTATGT			
amoA-1F	GGGGTTTCTACTGGTGGT	AOB *amoA* gene	95°C, 3.0min; 40×(95°C, 20s; 55°C, 30s; 72°C, 30s with plate read); Melt curve 65.0°C to 95.0°C, increment 0.5°C, 0:05s + plate read	Szukics et al., 2012
amoA-2R	CCCCTCGGGAAAGCCTTCTTC			

References

Francis CA, Roberts KJ, Beman JM, Santoro AE, Oakley BB (2005) Ubiquity and diversity of ammonia-oxidizing archaea in water columns and sediments of the ocean. Proc Natl Acad Sci U S A 102(41): 14683-14688.

Szukics U, Hackl E, Zechmeister-Boltenstern S, Sessitsch A (2012) Rapid and dissimilar response of ammonia oxidizing archaea and bacteria to nitrogen and water amendment in two temperate forest soils. Microbiol Res 167(2): 103-109.

Throbäck IN, Enwall K, Jarvis A, Hallin S (2004) Reassessing PCR primers targeting nirS, nirK and nosZ genes for community surveys of denitrifying bacteria with DGGE. FEMS Microbiol Ecol 49(3): 401-417.

Table S2. Summary of two-way ANOVA.

Dependent variable	Source	F value	*p* value
N_2O	Water regime	110.081	< 0.001*
	Incubation time	110.237	< 0.001*
	Regime×time	137.637	< 0.001*
NH_4^+-N	Water regime	1.826	0.139
	Incubation time	25.346	< 0.001*
	Regime×time	0.56	0.898
NO_3^--N	Water regime	2.961	0.028*
	Incubation time	2.531	0.052
	Regime×time	1.678	0.083
AOB *amoA*	Water regime	14.667	< 0.001*
	Incubation time	73.440	< 0.001*
	Regime×time	3.987	< 0.001*
AOA *amoA*	Water regime	61.085	< 0.001*
	Incubation time	66.249	< 0.001*
	Regime×time	22.961	< 0.001*
nirS	Water regime	10.159	< 0.001*
	Incubation time	17.602	< 0.001*
	Regime×time	3.504	< 0.001*
nosZ	Water regime	5.308	0.001*
	Incubation time	10.489	< 0.001*
	Regime×time	2.295	0.013*

Note: *, $p < 0.05$, statistically significant.

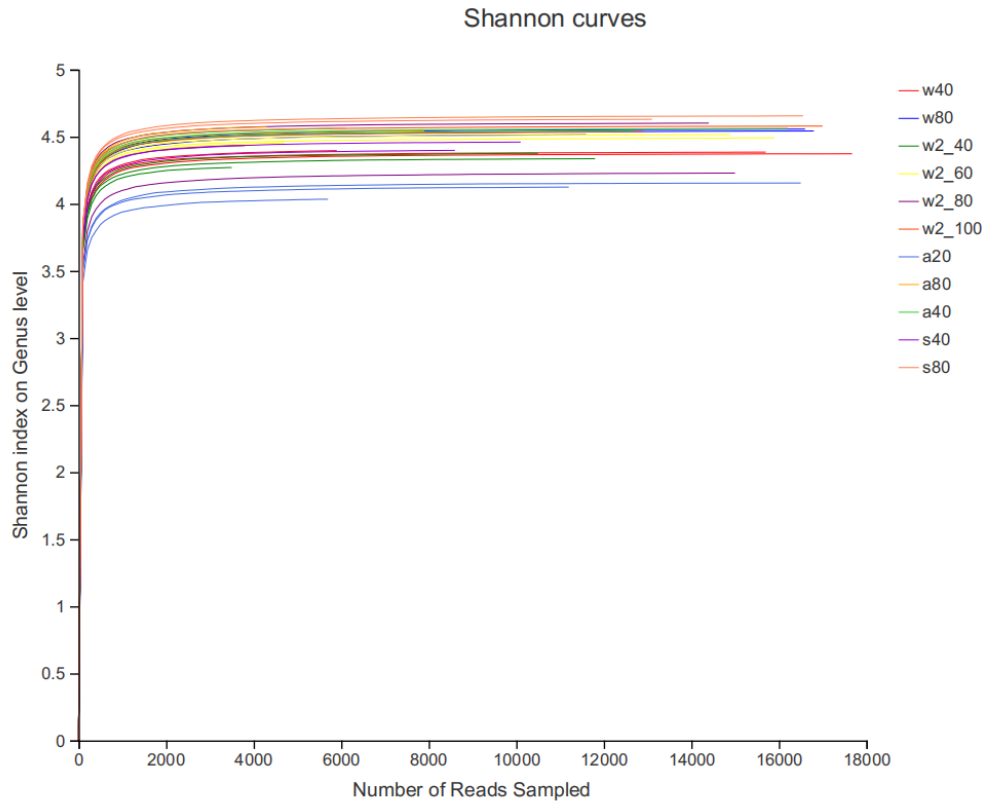
Table S3. Physicochemical properties of black soil sample.

Physicochemical property	Value
pH	7.22
organic matter	26.7 g/kg
total nitrogen	1.47 g/kg
NH_4^+-N	1.12 mg/kg
NO_3^--N	1.03 mg/kg
total potassium	25.16 g/kg
alkali-hydrolyzed nitrogen	151.1 mg/kg
available phosphorus	51.0 mg/kg
available potassium	200.0 mg/kg

Table S4. Intergroup difference of relative abundance of microbial functions predicted by FAPROTAX.

Table S4 Intergroup difference of relative abundance of microbial functions predicted by FAPROTAX																				
Functiona	Corrected	a20-mean	a20-sd	(%	a40-mean	a40-sd	(%	s40-mean	s40-sd	(%	s80-mean	s80-sd	(%	w2_100-m	w2_100-sd	w2_40-me	w2_40-sd	w2_60-me	w2_60-sd	w40-mean	w40-sd	('	w80-mean	w80-sd	('	Pvalue
chemohet	0.009581	14.46	2.185		23.35	1.41		25.53	1.244		21.95	0.4417		19.86	1.725	20.28	0.6377	23.59	0.3804	22.44	0.7614		22.54	1.026		0.004073
aerobic_ch	0.009581	13.9	2.09		21.68	1.146		23.66	1.31		19.61	0.2307		17.92	1.627	19.44	0.6207	21.86	0.3396	21.52	0.9318		20.31	1.083		0.003944
animal_pa	0.009252	15.15	1.064		9.541	0.8333		7.711	0.8365		6.805	0.1714		7.652	0.5111	11.64	0.387	8.855	0.3831	9.723	0.1502		7.317	0.2672		0.002002
human_pa	0.009252	14.6	1.309		9.226	0.8571		7.285	0.843		6.567	0.1157		7.361	0.4961	11.25	0.4089	8.072	0.4795	9.402	0.2393		7.045	0.2273		0.002427
human_pa	0.009252	14.45	1.415		8.677	0.5355		7.146	0.9383		6.546	0.1066		7.332	0.4918	11.16	0.4311	8.027	0.4872	9.371	0.2468		7.031	0.2224		0.002387
ureolysis	0.009252	13.89	0.9924		5.084	0.08034		4.237	0.4306		3.398	0.1789		3.005	0.3207	9.416	0.1269	5.101	0.3478	7.454	0.3638		3.073	0.2113		0.001376
nitrificatio	0.009252	2.318	0.3339		3.718	0.7367		4.709	0.4616		7.431	0.6128		8.048	0.2388	2.845	0.2587	4.702	0.4769	3.162	0.5986		6.705	0.5439		0.001883
aerobic_ar	0.009252	1.311	0.04065		2.409	0.3028		2.745	0.2711		5.681	0.3122		5.593	0.2148	1.643	0.2151	3.094	0.28	1.583	0.05274		4.393	0.2903		0.001558
respiratior	0.009252	0.9716	0.101		1.63	0.3208		2.479	0.2366		2.742	0.1627		3.499	0.4419	1.465	0.1307	1.805	0.2186	1.945	0.1349		2.718	0.1313		0.002497
sulfur_resp	0.009252	0.9527	0.09063		1.623	0.3218		2.468	0.2265		2.739	0.1631		3.486	0.4431	1.465	0.1307	1.782	0.2176	1.935	0.1426		2.703	0.1368		0.002559
aerobic_ni	0.02708	1.007	0.3346		1.308	0.4979		1.964	0.2658		1.75	0.3026		2.455	0.4495	1.203	0.1417	1.608	0.2171	1.578	0.5729		2.311	0.2882		0.01713
nitrate_rec	0.2699	1.303	0.2937		1.116	0.2195		1.168	0.3242		1.714	0.07748		1.312	0.3237	1.279	0.1196	1.136	0.1241	1.351	0.22		1.263	0.09459		0.2038
aromatic_(	0.009561	0.4551	0.262		1.459	0.2744		2.07	0.646		0.4264	0.1223		0.4306	0.0428	1.21	0.258	1.39	0.2179	2.624	0.2477		0.6845	0.2506		0.003317
chitinolysis	0.009252	0.2933	0.05092		1.428	0.1065		1.861	0.2992		0.8469	0.1416		1.65	0.1527	0.6981	0.246	1.628	0.2393	0.4155	0.1214		1.396	0.1177		0.002832
fermentati	0.01432	0.6215	0.1091		1.858	0.8821		0.8173	0.2888		1.318	0.1783		0.7829	0.07441	0.7494	0.1651	0.7174	0.1613	1.109	0.1392		1.005	0.08652		0.008183
nitrogen_f	0.1382	0.384	0.08541		0.9033	0.102		0.5456	0.1956		0.6627	0.115		0.6659	0.06505	0.6342	0.1727	0.6794	0.2705	0.6381	0.08853		0.5771	0.08373		0.1016
cellulolysis	0.009407	0.2113	0.06964		0.6822	0.1955		0.4099	0.05596		1.389	0.1302		0.6326	0.1714	0.3248	0.05968	0.4304	0.1081	0.4133	0.04163		1.084	0.1763		0.003072
invertebra	0.07116	0.5481	0.2449		0.3153	0.1258		0.4258	0.1005		0.2382	0.05749		0.2902	0.05634	0.3831	0.03558	0.7826	0.1064	0.3207	0.0995		0.2726	0.04748		0.04938
predatory_	0.01041	0.1369	0.02836		0.1708	0.008274		0.2321	0.09311		0.5399	0.06944		0.6382	0.1412	0.1542	0.0147	0.3438	0.07985	0.2569	0.1038		0.8886	0.2172		0.005345
phototrop	0.009581	0.1066	0.03232		0.346	0.09559		0.1292	0.03402		0.5429	0.1476		0.6149	0.1474	0.1125	0.04486	0.4673	0.0482	0.1662	0.008974		0.7093	0.2356		0.003538
photoautc	0.009581	0.08981	0.02962		0.3273	0.08833		0.1292	0.03402		0.5327	0.1378		0.594	0.1584	0.1096	0.04597	0.4472	0.05354	0.14	0.01626		0.7066	0.2379		0.004106
plant_path	0.02708	0.5082	0.27		0.2541	0.1278		0.3668	0.1112		0.1857	0.06084		0.1205	0.02496	0.3582	0.09658	0.8086	0.08365	0.2874	0.09686		0.1754	0.05535		0.01675
nitrate_res	0.02859	0.2847	0.009306		0.2579	0.08529		0.2258	0.06118		0.5426	0.0767		0.4927	0.07057	0.2571	0.05647	0.2276	0.07874	0.2538	0.07547		0.4072	0.08098		0.01926
nitrogen_r	0.02859	0.2847	0.009306		0.2579	0.08529		0.2258	0.06118		0.5426	0.0767		0.4927	0.07057	0.2571	0.05647	0.2276	0.07874	0.2538	0.07547		0.4072	0.08098		0.01926
nitrite_resp	0.02554	0.2847	0.009306		0.2519	0.09549		0.2057	0.06751		0.5401	0.07426		0.4927	0.07057	0.2571	0.05647	0.2276	0.07874	0.248	0.06914		0.4072	0.08098		0.01512
cyanobact	0.009252	0.03463	0.02256		0.2738	0.06104		0.1089	0.01103		0.4662	0.1739		0.5483	0.1553	0.04846	0.005249	0.4007	0.02969	0.1039	0.01609		0.654	0.21		0.002528
oxygenic_p	0.009252	0.03463	0.02256		0.2738	0.06104		0.1089	0.01103		0.4662	0.1739		0.5483	0.1553	0.04846	0.005249	0.4007	0.02969	0.1039	0.01609		0.654	0.21		0.002528
manganes	0.138	0.2373	0.02116		0.2565	0.0377		0.2397	0.1264		0.4921	0.09967		0.2377	0.03258	0.1451	0.08671	0.2583	0.05192	0.3016	0.05685		0.2346	0.03348		0.09858
intracellula	0.009838	0.1239	0.02172		0.1349	0.04866		0.2084	0.07167		0.2759	0.06847		0.4944	0.08604	0.1006	0.03304	0.1893	0.07553	0.09559	0.0463		0.436	0.08504		0.004819
methylotr	0.009838	0.1102	0.007786		0.2003	0.04254		0.09792	0.02828		0.3348	0.07134		0.2953	0.06907	0.1427	0.01642	0.09678	0.06248	0.0914	0.01207		0.2509	0.07518		0.0048
methanol_	0.009838	0.1102	0.007786		0.2003	0.04254		0.09792	0.02828		0.3348	0.07134		0.2953	0.06907	0.1427	0.01642	0.09678	0.06248	0.0914	0.01207		0.2509	0.07518		0.0048
dark_hydr	0.01289	0.07004	0.0193		0.05946	0.03663		0.03576	0.009885		0.3178	0.01148		0.2988	0.02054	0.06317	0.01621	0.025	0.003978	0.05334	0.04433		0.1683	0.03346		0.007105
nitrite_der	0.3194	0.1234	0.02588		0.1091	0.05543		0.05611	0.03312		0.08147	0.05279		0.05252	0.02261	0.1243	0.05856	0.07146	0.02656	0.0895	0.04359		0.08179	0.02998		0.2673
nitrous_ox	0.3194	0.1234	0.02588		0.1091	0.05543		0.05611	0.03312		0.08147	0.05279		0.05252	0.02261	0.1243	0.05856	0.07146	0.02656	0.0895	0.04359		0.08179	0.02998		0.2673
nitrate_de	0.3194	0.1234	0.02588		0.1091	0.05543		0.05611	0.03312		0.08147	0.05279		0.05252	0.02261	0.1243	0.05856	0.07146	0.02656	0.0895	0.04359		0.08179	0.02998		0.2673
denitrifica	0.3194	0.1234	0.02588		0.1091	0.05543		0.05611	0.03312		0.08147	0.05279		0.05252	0.02261	0.1243	0.05856	0.07146	0.02656	0.0895	0.04359		0.08179	0.02998		0.2673
iron_respir	0.01041	0.006152	0.005523		0.01399	0.01266		0	0		0.3061	0.02113		0.2919	0.0185	0	0	0.0107	0.01296	0.003748	0.006492		0.1418	0.04403		0.005525
knallgas_b	0.009252	0.001781	0.003084		0.003851	0.006671		0	0		0.3028	0.0242		0.2919	0.0185	0	0	0	0	0	0		0.1391	0.04829		0.002811
fumarate_	0.009252	0.001781	0.003084		0.003851	0.006671		0	0		0.3028	0.0242		0.2919	0.0185	0	0	0	0	0	0		0.1391	0.04829		0.002811
nitrate_am	0.009252	0.001781	0.003084		0.003851	0.006671		0	0		0.3028	0.0242		0.2919	0.0185	0	0	0	0	0	0		0.1391	0.04829		0.002811
nitrite_am	0.009252	0.001781	0.003084		0.003851	0.006671		0	0		0.3028	0.0242		0.2919	0.0185	0	0	0	0	0	0		0.1391	0.04829		0.002811
photohete	0.5411	0.072	0.02517		0.07219	0.04554		0.02035	0.02409		0.07666	0.03116		0.06661	0.02699	0.06405	0.0417	0.06664	0.01856	0.06229	0.02403		0.05533	0.02709		0.519
anoxygeni	0.7422	0.05518	0.01397		0.05354	0.03188		0.02035	0.02409		0.0665	0.04112		0.04571	0.0283	0.06117	0.04236	0.04646	0.02392	0.03617	0.003409		0.05257	0.02835		0.7422
anoxygeni	0.7422	0.05518	0.01397		0.05354	0.03188		0.02035	0.02409		0.0665	0.04112		0.04571	0.0283	0.06117	0.04236	0.04646	0.02392	0.03617	0.003409		0.05257	0.02835		0.7422
sulfate_res	0.3287	0.01892	0.012		0.006589	0.005946		0.01071	0.01855		0.002567	0.004446		0.01256	0.01416	0	0	0.02259	0.002211	0.00937	0.01623		0.01494	0.008825		0.2818
hydrocarb	0.4073	0.009056	0.004496		0.0212	0.01272		0.01462	0.01626		0.002567	0.004446		0.003257	0.005641	0.01096	0.01228	0.01311	0.01039	0.01656	0.01057		0.006797	0.006191		0.3741
aromatic_l	0.3412	0.009056	0.004496		0.0212	0.01272		0.01462	0.01626		0.002567	0.004446		0.003257	0.005641	0.005573	0.004835	0.01311	0.01039	0.01656	0.01057		0.006797	0.006191		0.3064
aliphatic_r	0.3412	0.009056	0.004496		0.0212	0.01272		0.01462	0.01626		0.002567	0.004446		0.003257	0.005641	0.005573	0.004835	0.01311	0.01039	0.01656	0.01057		0.006797	0.006191		0.3064
dark_oxida	0.5232	0.004371	0.003976		0.009327	0.008437		0.01071	0.01855		0.01016	0.01033		0.007106	0.01231	0.01722	0.009152	0	0	0.008551	0.01033		0.002626	0.004549		0.4912

(**A**)



(**B**)

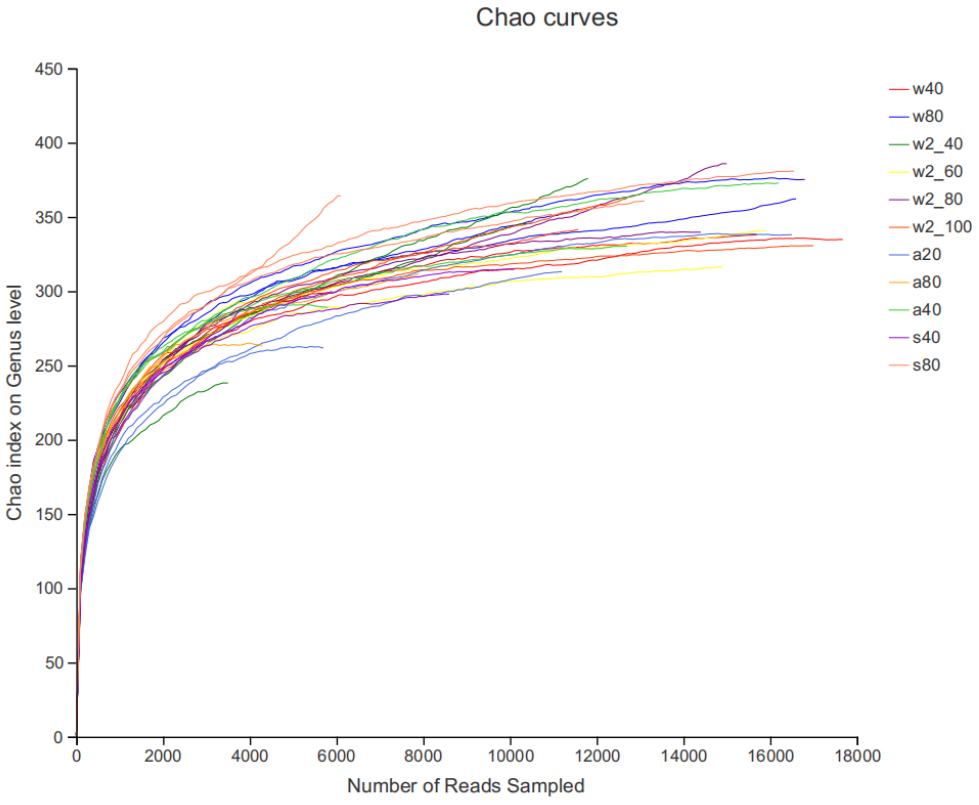
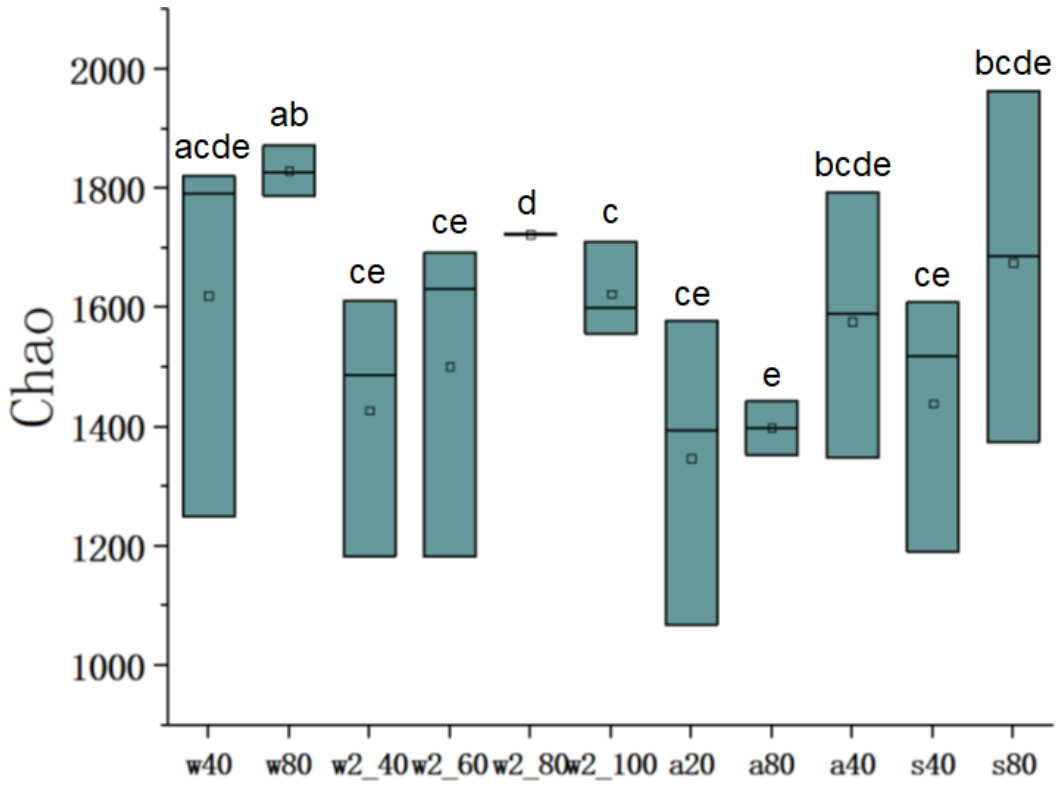


Figure S1. (A): rarefac,Shannon. (B): rarefac,Chao.

(A)



(B)

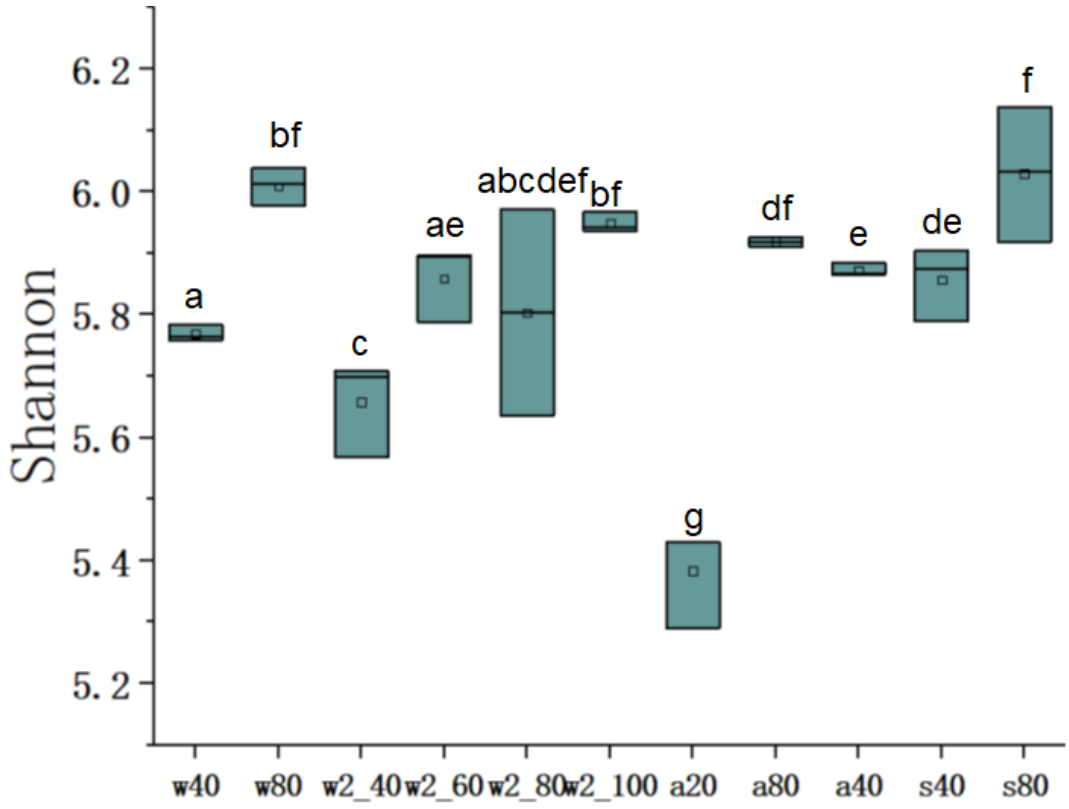
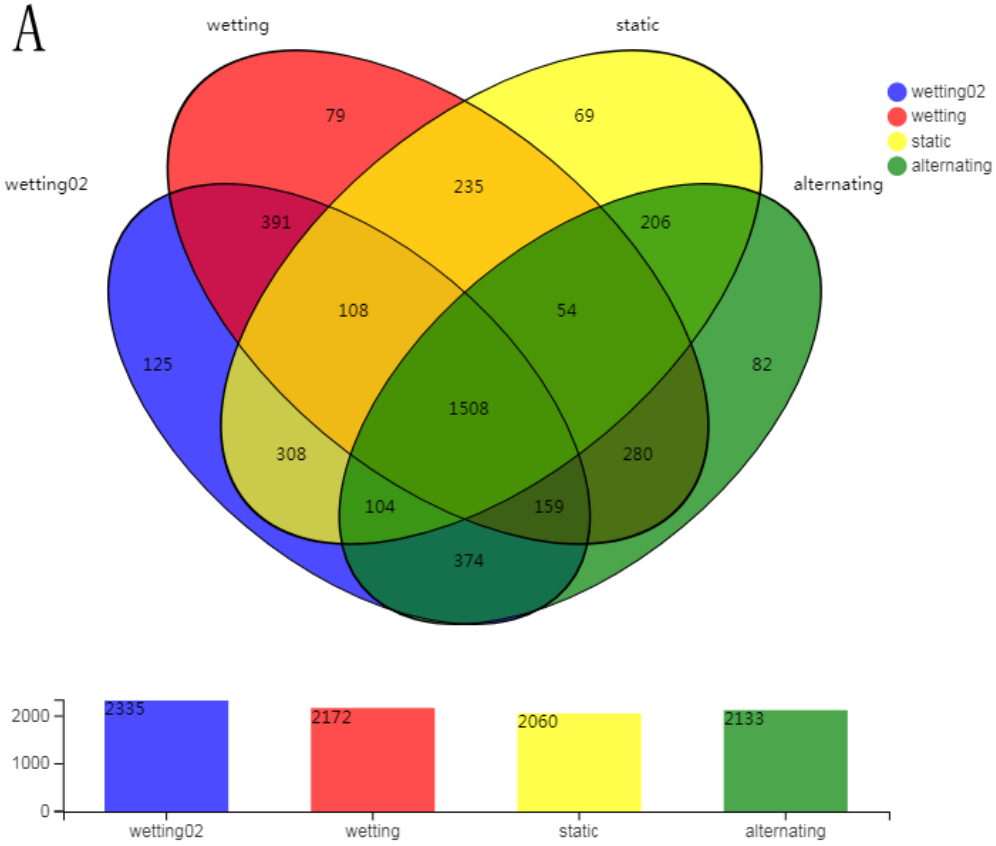
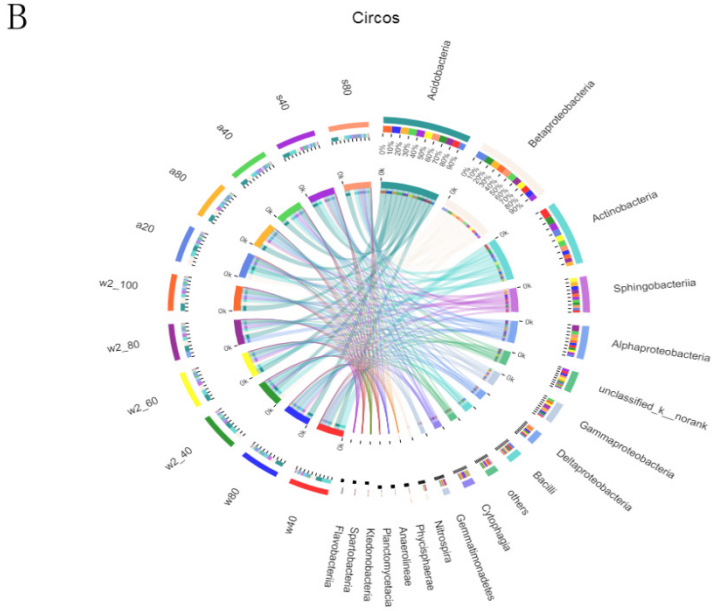


Figure S2. (A): Chao box plot. (B): Shannon box plot.

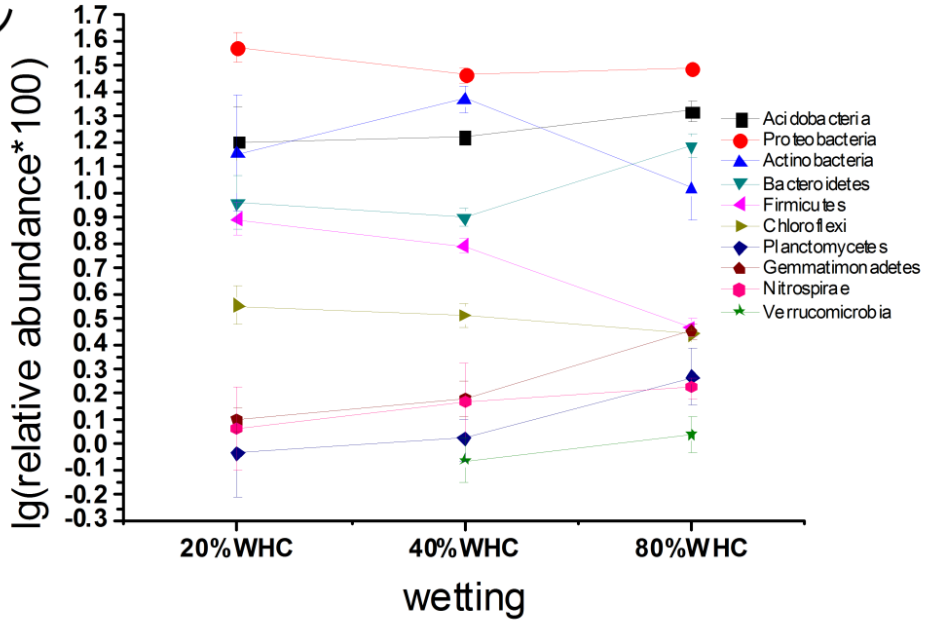
A


wetting
static
wetting02
alternating
79
69
235
391
206
108
54
125
82
1508
308
280
104
159
374
wetting02
wetting
static
alternating
2335
2172
2060
2133
2000
1000
0

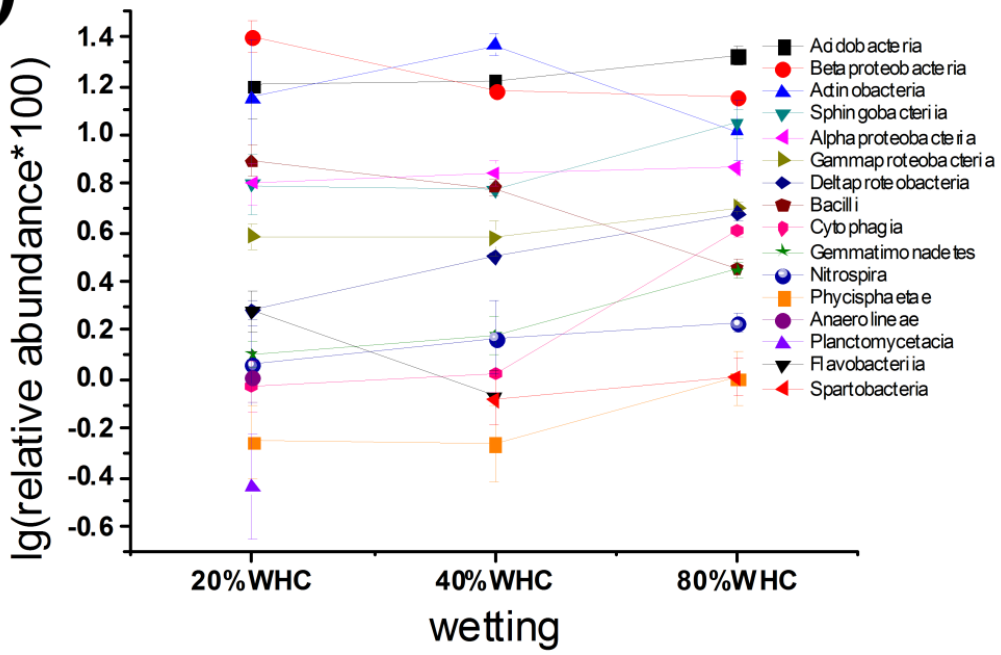
B


Circos
Acidobacteria
Betaproteobacteria
Actinobacteria
Sphingobacteriia
Alphaproteobacteria
unclassified_k__norank
Gammaproteobacteria
Deltaproteobacteria
Bacilli
others
Cytophagia
Gammatimonadetes
Nitrospira
Phycisphaerae
Anaerolineae
Planctomycetacia
Kiloniellacteria
Sphingobacteriia
Flavobacteriia
s80
s40
a40
a80
a20
w2_100
w2_80
w2_60
w2_40
w80
w40

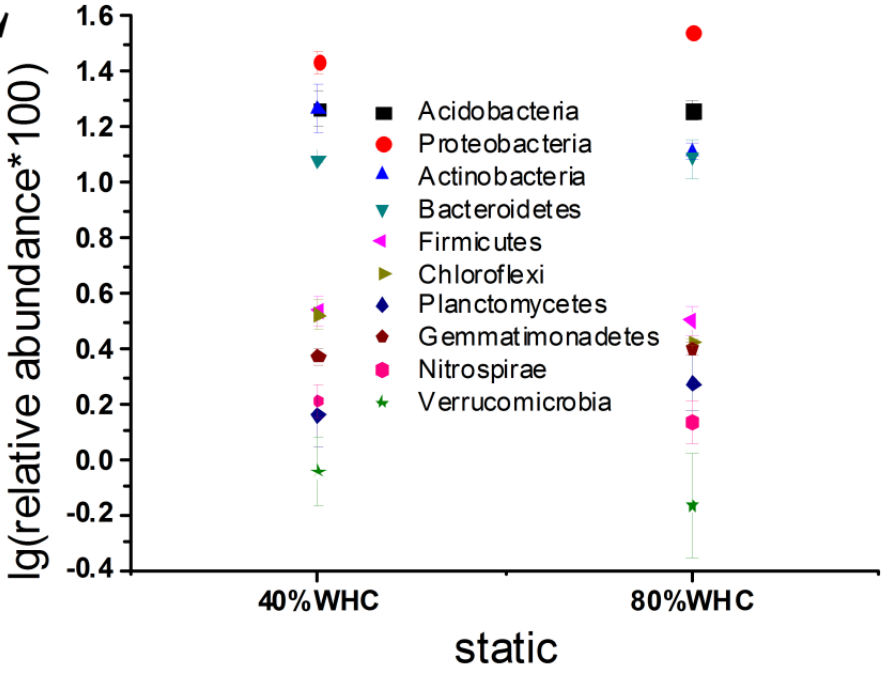
C


lg(relative abundance*100)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
20%WHC
40%WHC
80%WHC
wetting
Acidobacteria
Proteobacteria
Actinobacteria
Bacteroidetes
Firmicutes
Chloroflexi
Planctomycetes
Gemmatimonadetes
Nitrospirae
Verrucomicrobia

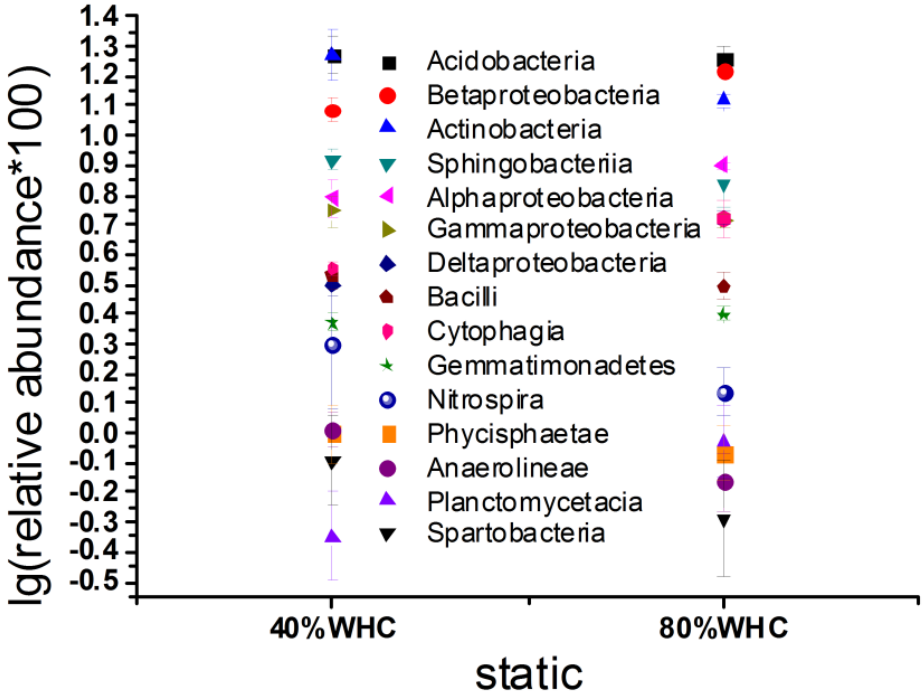
D


lg(relative abundance*100)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
20%WHC
40%WHC
80%WHC
wetting
Acidobacteria
Betaproteobacteria
Actinobacteria
Sphingobacteriia
Alphaproteobacteria
Gammaproteobacteria
Deltaproteobacteria
Bacilli
Cytophagia
Gemmatimonadetes
Nitrospira
Phycisphaerae
Anaerolineae
Planctomycetacia
Flavobacteriia
Spartobacteria

E


lg(relative abundance*100)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
Acidobacteria
Proteobacteria
Actinobacteria
Bacteroidetes
Firmicutes
Chloroflexi
Planctomycetes
Gemmatimonadetes
Nitrospirae
Verrucomicrobia
40%WHC
80%WHC
static

F


lg(relative abundance*100)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
Acidobacteria
Betaproteobacteria
Actinobacteria
Sphingobacteriia
Alphaproteobacteria
Gammaproteobacteria
Deltaproteobacteria
Bacilli
Cytophagia
Gemmatimonadetes
Nitrospira
Phycisphaetae
Anaerolineae
Planctomycetacia
Spartobacteria
40%WHC
80%WHC
static

G

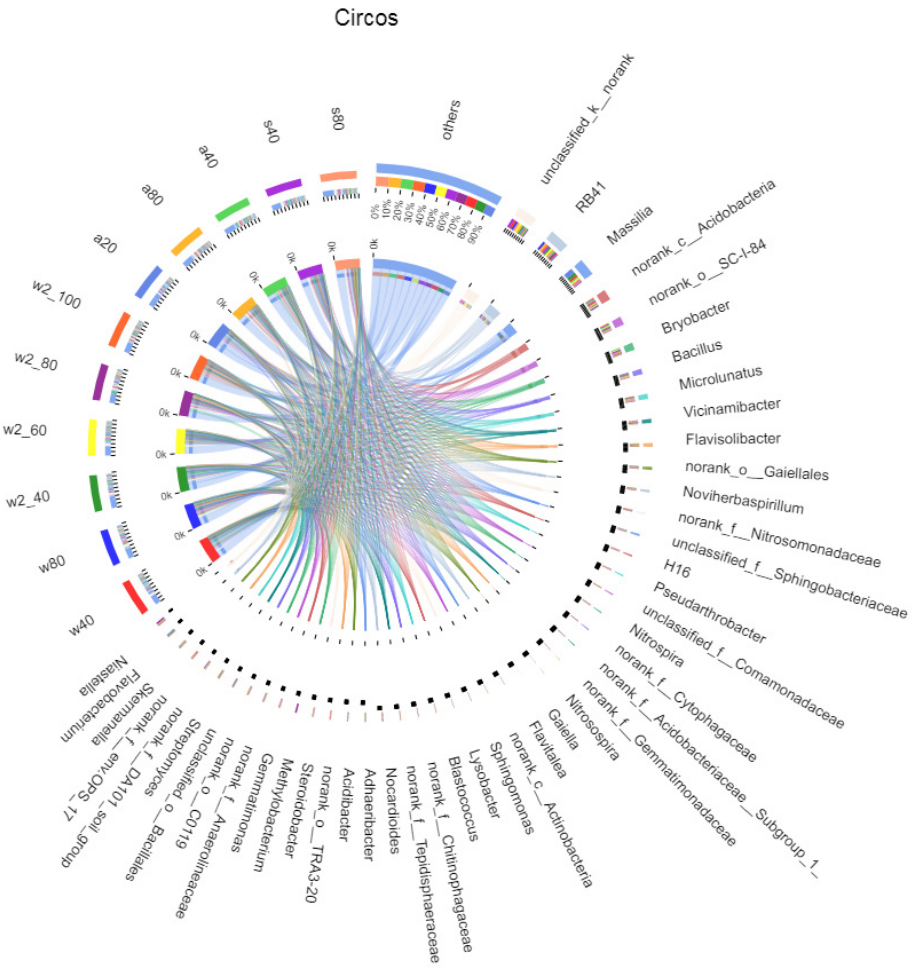


Figure S3. (A): Venn,4 regime,OUT. (B): circos,class level,11 sample group. (C): phyla,wetting. (D): class,wetting. (E): static,phyla. (F): class,static. (G): genus,circos,11 sample group.

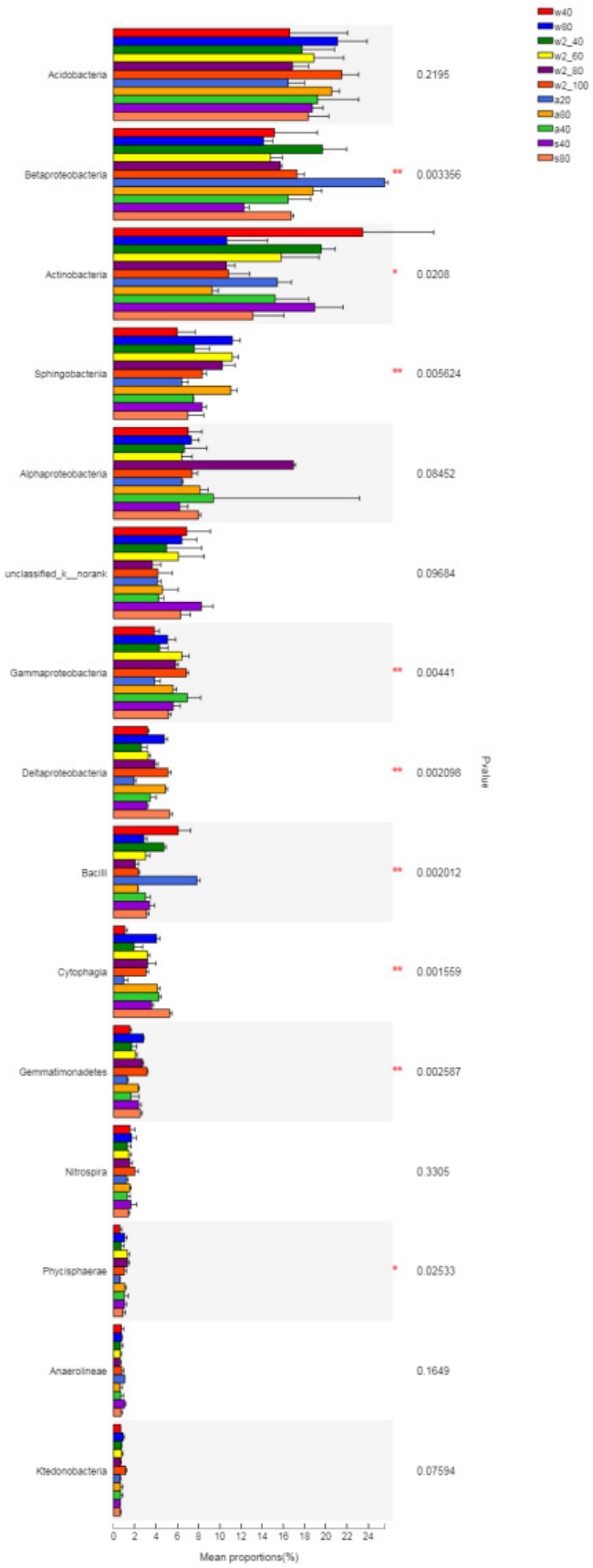


Figure S4. rank sum,11 group,class level.

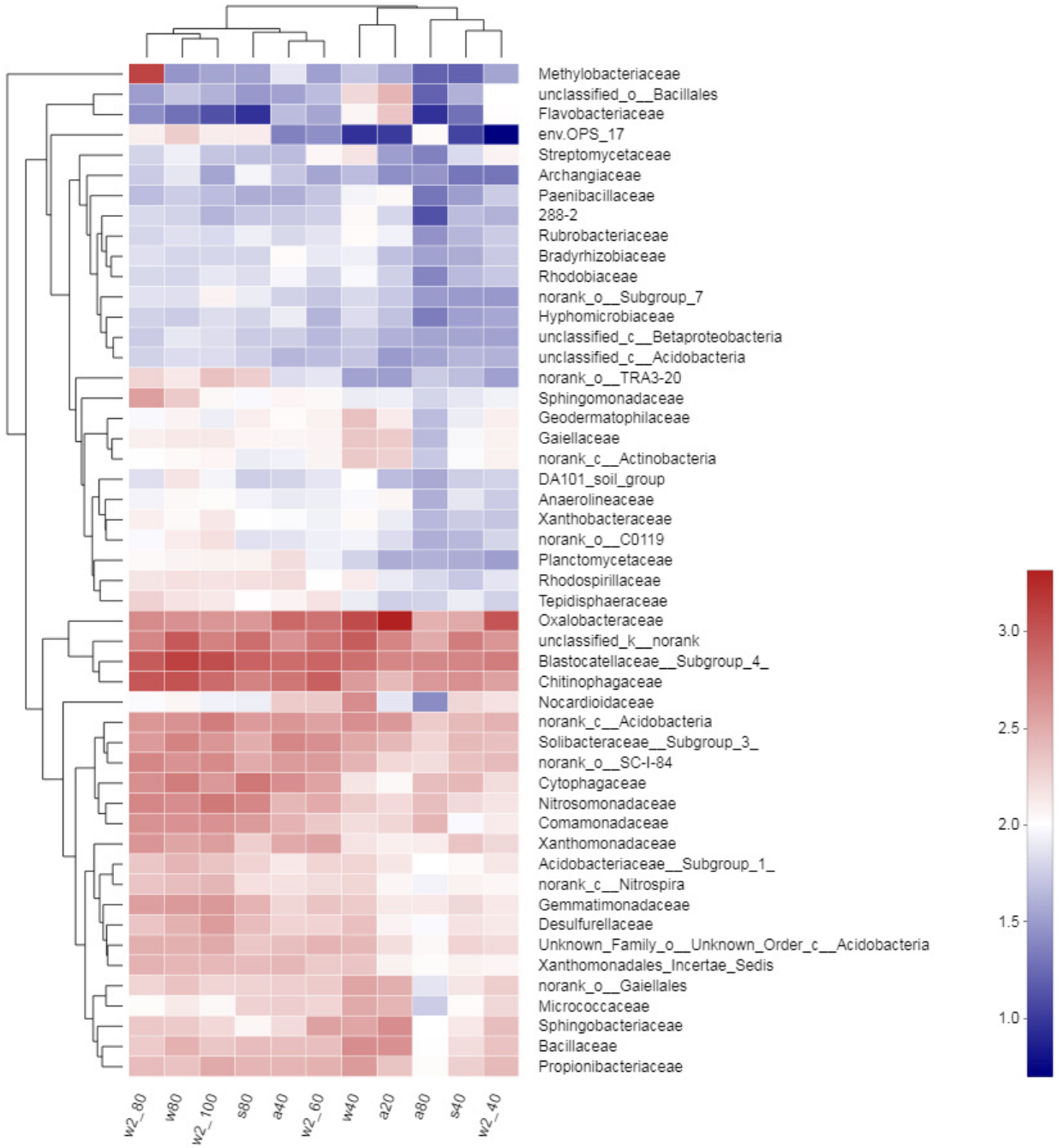
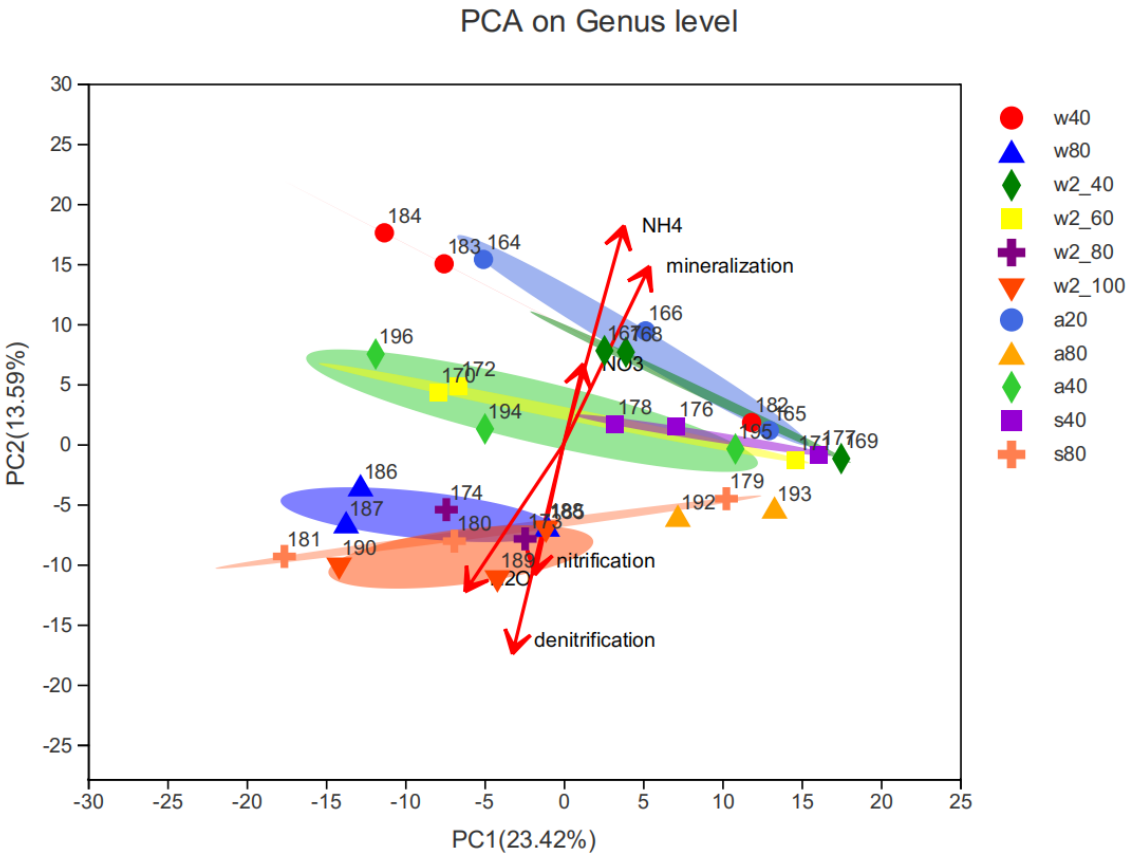


Figure S5. 50 families,11 sample group,heatmap.

(A)



(B)

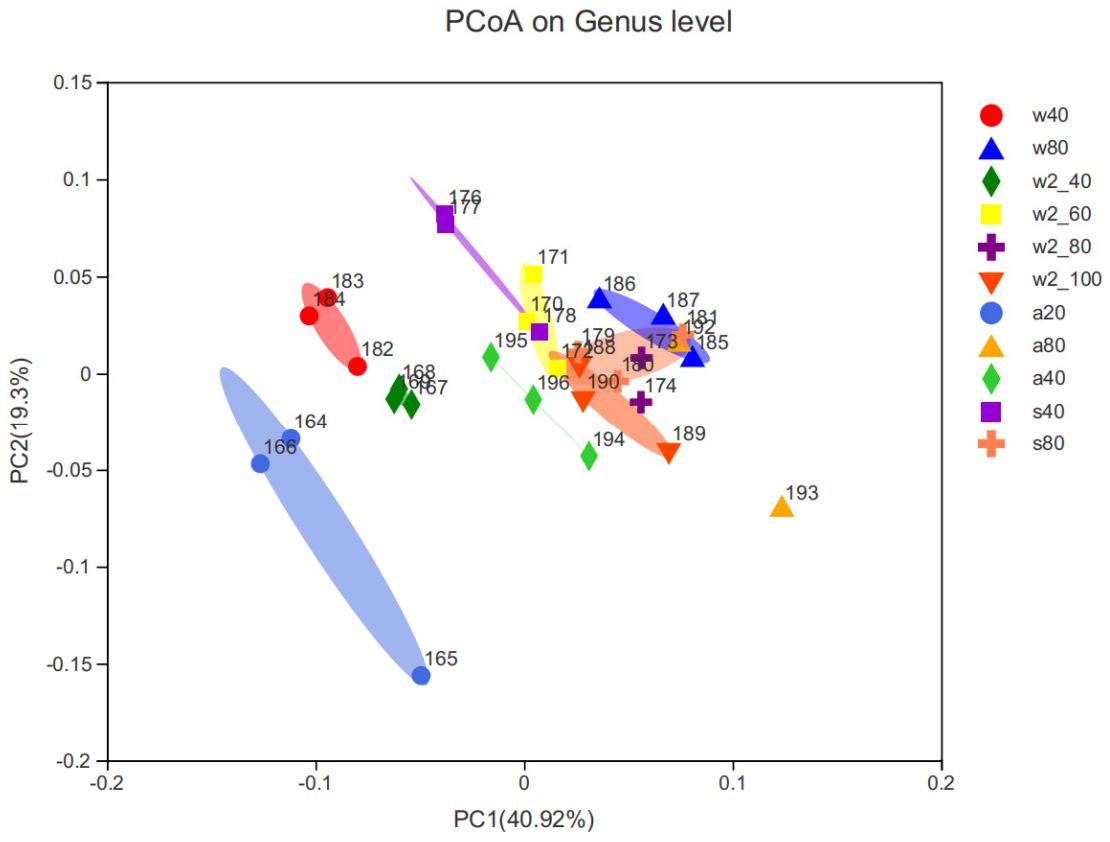


Figure S6. (A): PCA,genus level. (B): PCoA,genus level.

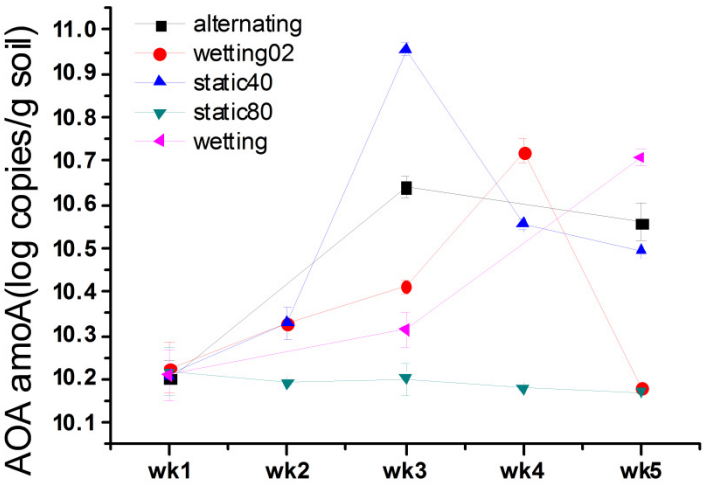


Figure S7. AOA amoA.

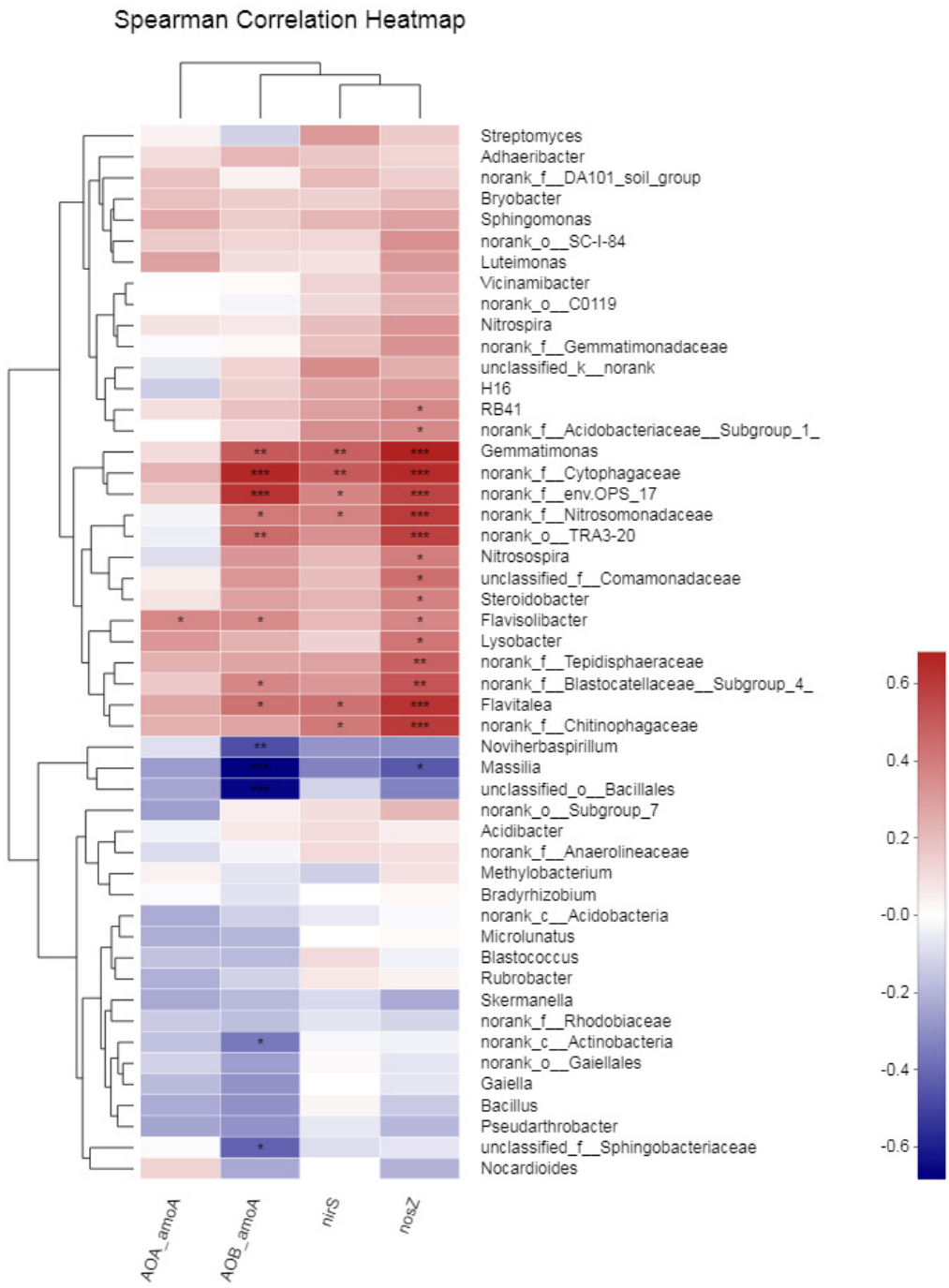


Figure S8. Spearman,4 gene.