Supplementary Information for Publication

Influence of bio-fertilizer type and amount jointly on microbial community composition, crop production and soil health

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Table S1 The membership degree of the evaluation alternatives

Treatment	Soil bulk density	Field capacity	Soil moisture content	Soil porosity	Eh	pH	CEC	SOC	MWD	GMD	D
CK	0.25	0.29	0.36	0.25	1.00	1.00	0.37	0.00	0.00	0.00	0.00
EM1	1.00	1.00	1.00	1.00	0.82	0.94	0.83	1.00	0.87	0.89	0.98
TC1	0.58	0.60	0.42	0.58	0.61	0.90	1.00	0.52	0.34	0.31	0.23
EM2	0.24	0.20	0.29	0.24	0.00	0.48	0.13	0.43	0.46	0.42	0.30
TC2	0.39	0.57	0.03	0.39	0.41	0.00	0.18	0.22	1.00	1.00	1.00
CF	0.00	0.00	0.00	0.00	0.71	0.19	0.00	0.16	0.32	0.32	0.44
Treatment	**TN**	**TP**	**TK**	**AP**	**AK**	**C/N**	**Active carbon**	**Slow carbon**	**Resistant carbon**	**Microbial quotient**	**SMBN**
CK	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	1.00	0.31
EM1	1.00	1.00	0.75	0.37	1.00	1.00	1.00	1.00	0.94	0.79	0.54
TC1	0.91	0.87	1.00	1.00	0.91	0.19	0.94	0.72	1.00	0.77	1.00
EM2	0.33	0.35	0.68	0.49	0.47	0.78	0.66	0.51	0.63	0.49	0.00
TC2	0.51	0.31	0.66	0.51	0.35	0.00	0.82	0.46	0.41	0.22	0.33
CF	0.26	0.41	0.48	0.00	0.11	0.22	0.11	0.23	0.02	0.00	0.22
Treatment	**Catalase**	**SAC**	**DEH**	**URE**	**ALP**	**Cu**	**As**	**Cd**	**Pb**	**Zn**	**Gene copy number**
CK	1.00	0.43	0.81	0.98	0.00	0.00	0.35	0.22	1.00	0.00	0.04
EM1	0.37	0.94	0.46	0.86	0.66	0.94	0.63	1.00	0.63	1.00	1.00
TC1	0.43	1.00	0.00	0.75	1.00	1.00	1.00	0.78	0.36	0.75	0.78
EM2	0.29	0.71	0.18	1.00	0.31	0.47	0.00	0.78	0.31	0.62	0.49
TC2	0.04	0.74	1.00	0.00	0.72	0.46	0.43	0.56	0.19	0.41	0.40
CF	0.00	0.00	0.18	0.02	0.07	0.28	0.33	0.00	0.00	0.03	0.00

Note: Soil total carbon was represented by SOC (g/kg). Mean weight diameter was represented by MWD. Mean geometric diameter was represented by GMD. Fractal dimension was

represented by D. Soil total nitrogen was represented by TN (g/kg). Soil total phosphorus was represented by TP (g/kg). Soil total potassium was represented by TK (g/kg). Soil available phosphorus was represented by AP (g/kg). Soil available potassium was represented by AK (g/kg). Alkali phosphatase activity was represented by ALP (Phenol mg/g). Invertase activity was represented by SAC (Glucose mg/g). Soil dehydrogenase activity was represented by DEH (TPF ug/g). Urease activity was represented by URE (NH_4^+-N, mg/g). Soil microbial nitrogen was represented by SMBN (mg/kg).

Table S2 Load count of different soil indicators

Soil indicators	First principal component	Second principal component	Third principal component	Fourth principal component	Fifth principal component
Soil bulk density	0.918	0.212	0.281	0.174	-0.062
Field capacity	0.879	0.125	0.314	0.333	0.047
Soil moisture content	0.739	0.514	0.340	-0.090	-0.257
Soil porosity	0.918	0.212	0.281	0.174	-0.062
Eh	-0.080	0.583	0.062	0.654	-0.471
pH	0.385	0.914	-0.061	-0.057	-0.095
CEC	0.818	0.463	-0.259	0.219	-0.037
SOC	0.911	-0.004	0.205	-0.207	-0.292
MWD	0.555	-0.654	0.469	0.185	0.099
GMD	0.546	-0.637	0.494	0.217	0.068
D	0.472	-0.616	0.537	0.309	-0.118
TN	0.962	-0.149	-0.114	0.121	-0.156
TP	0.897	-0.090	-0.178	-0.010	-0.395
TK	0.788	-0.465	-0.373	-0.153	0.021
AP	0.726	-0.164	-0.501	-0.053	0.439

AK	0.987	-0.006	-0.102	-0.099	-0.078
C/N	0.494	0.192	0.471	-0.632	-0.313
Active carbon	0.927	-0.298	0.014	-0.028	0.226
Slow carbon	0.964	-0.178	0.072	-0.119	-0.140
Resistant carbon	0.963	-0.022	-0.149	-0.196	0.106
Microbial quotient	0.358	0.903	0.074	0.020	0.226
SMBN	0.645	0.251	-0.544	0.472	-0.043
Catalase	-0.097	0.966	0.063	0.059	0.223
SAC	0.883	0.118	0.018	-0.015	0.454
DEH	-0.256	0.003	0.660	0.573	0.412
URE	0.305	0.784	0.092	-0.502	0.179
ALP	0.851	-0.245	-0.283	0.246	0.275
Cu	0.955	-0.138	-0.238	-0.032	-0.108
As	0.632	0.187	-0.486	0.562	-0.119
Cd	0.913	0.019	0.170	-0.266	0.258
Pb	0.055	0.910	0.349	0.128	0.175
Zn	0.966	-0.059	0.084	-0.235	0.040
Gene copy number	0.992	0.012	0.059	-0.105	0.025

Note: Soil total carbon was represented by SOC (g/kg). Mean weight diameter was represented by MWD. Mean geometric diameter was represented by GMD. Fractal dimension was represented by D. Soil total nitrogen was represented by TN (g/kg). Soil total phosphorus was represented by TP (g/kg). Soil total potassium was represented by TK (g/kg). Soil available phosphorus was represented by AP (g/kg). Soil available potassium was represented by AK (g/kg). Alkali phosphatase activity was represented by ALP (Phenol mg/g). Invertase activity was represented by SAC (Glucose mg/g). Soil dehydrogenase activity was represented by DEH (TPF ug/g). Urease activity was represented by URE (NH_4^+-N, mg/g). Soil microbial nitrogen was represented by SMBN (mg/kg).

Table S3 Different weights of evaluation indexes

Soil indicators	Weight	Soil indicators	Weight
Soil bulk density	0.0471	Active carbon	0.0315
Field capacity	0.0477	Slow carbon	0.0310
Soil moisture content	0.0420	Resistant carbon	0.0329
Soil porosity	0.0471	Microbial quotient	0.0393
Eh	0.0158	SMBN	0.0287
pH	0.0335	Catalase	0.0235
CEC	0.0413	SAC	0.0425
SOC	0.0321	DEH	0.0142
MWD	0.0177	URE	0.0264
GMD	0.0183	ALP	0.0296
D	0.0158	Cu	0.0283
TN	0.0320	As	0.0281
TP	0.0251	Cd	0.0378
TK	0.0116	Pb	0.0332
AP	0.0206	Zn	0.0345
AK	0.0342	Gene copy number	0.0386
C/N	0.0182		

Note: Soil total carbon was represented by SOC (g/kg). Mean weight diameter was represented by MWD. Mean geometric diameter was represented by GMD. Fractal dimension was represented by D. Soil total nitrogen was represented by TN (g/kg). Soil total phosphorus was represented by TP (g/kg). Soil total potassium was represented by TK (g/kg). Soil available phosphorus was represented by AP (g/kg). Soil available potassium was represented by AK (g/kg).

TableS4 Soil health comprehensive evaluation index in different fertilizer treatments

Treatment	CK	EM1	TC1	EM2	TC2	CF
SHI	0.30	0.88	0.73	0.41	0.41	0.12