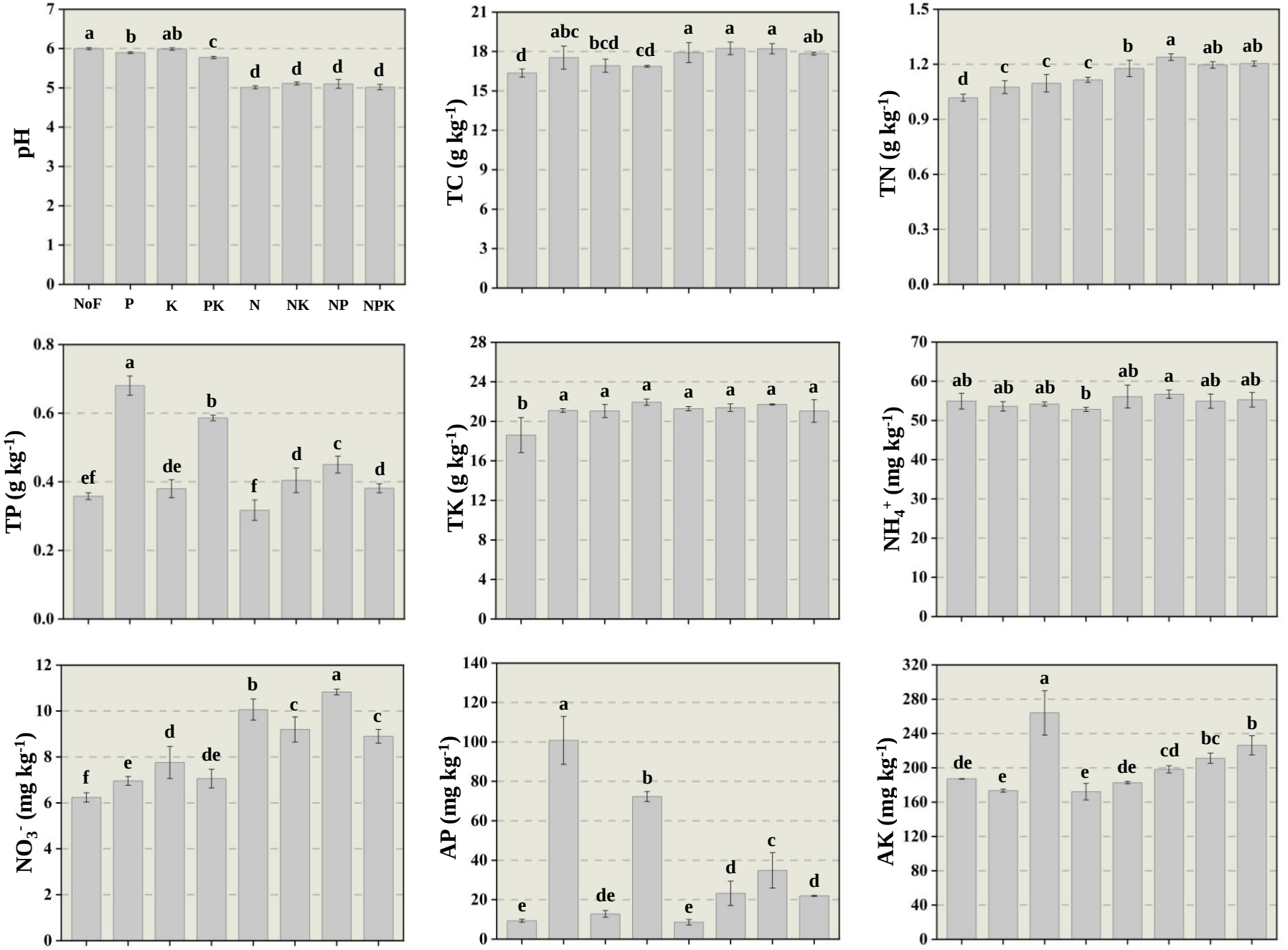


Fig. S1. Soil properties under long-term different fertilization regimes. Bars with different letters indicate significant differences ($P < 0.05$, ANOVA). TC, soil total carbon; TN, soil total nitrogen; TP, soil total phosphorus; TK, soil total potassium; AP, soil available phosphorus; AK, soil available potassium.

Fig. S1

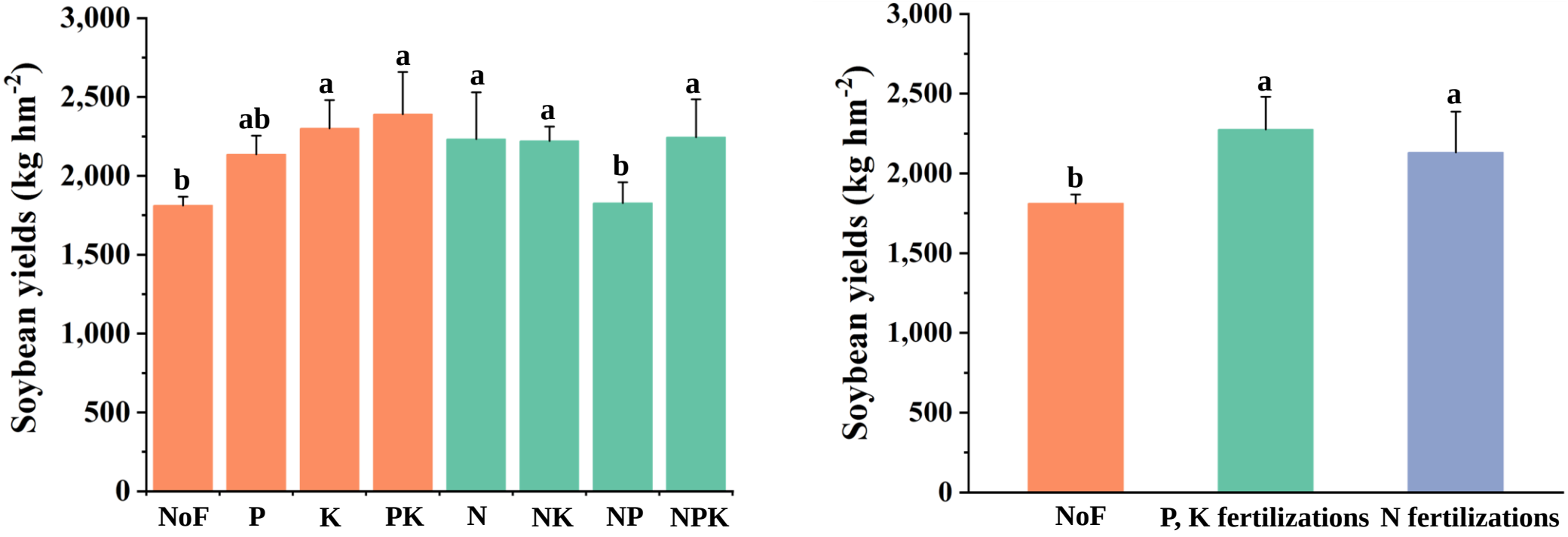


Fig. S2. Soybean yields in sampling year (2014) under long-term different fertilization regimes (a). Soybean yields for NoF, for P, K fertilizations and for N fertilization (b). Bars with different letters indicate significant differences ($P < 0.05$, ANOVA). P, K fertilizations include P, K and PK fertilization treatments, and N fertilizations include N, NK, NP and NPK fertilization treatments.

Fig. S2

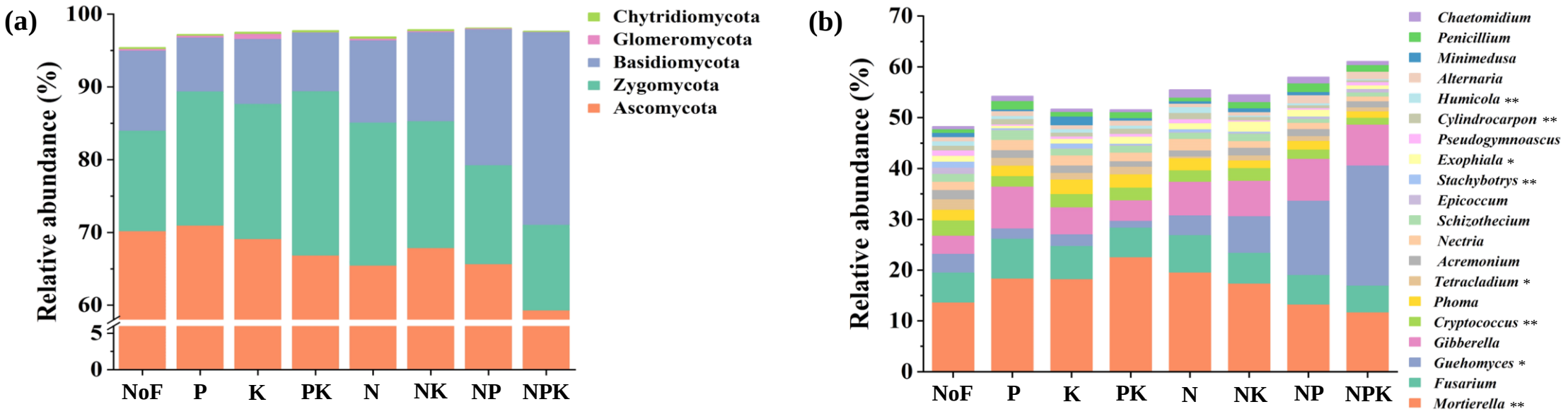


Fig. S3. Relative abundances of dominant fungal phyla (a) and genus (b). Asterisk indicate the significant differences ($P < 0.05$, ANOVA).

Fig. S3

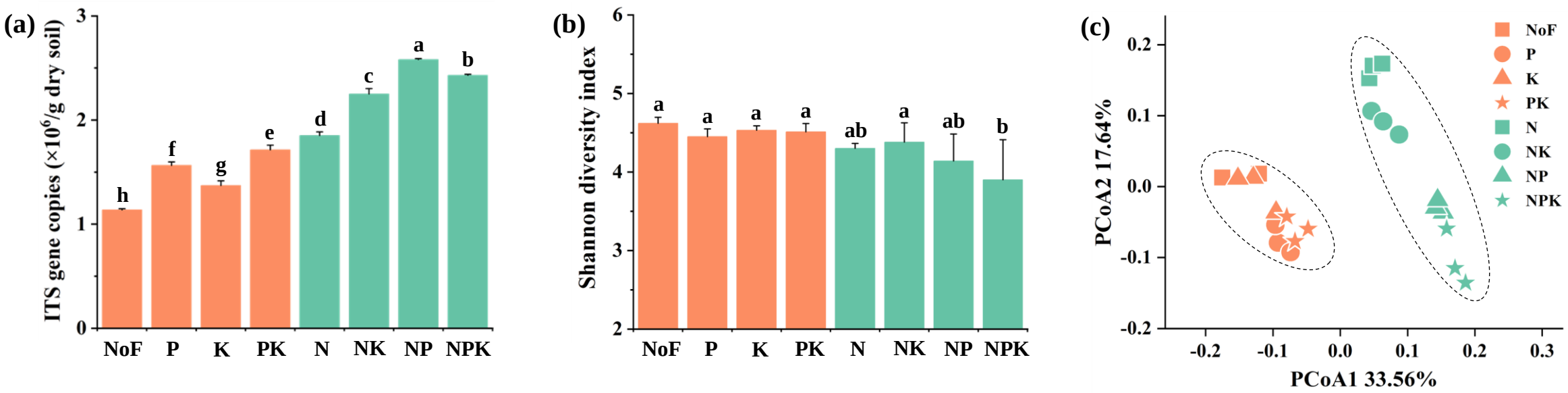


Fig. S4. Fungal abundance (a), Shannon diversity index (b) and fungal community structure represented by principal coordinates analysis (PCoA) (c) under long-term different fertilization regimes. Bars with different letters indicate significant differences ($P < 0.05$, ANOVA).

Fig. S4

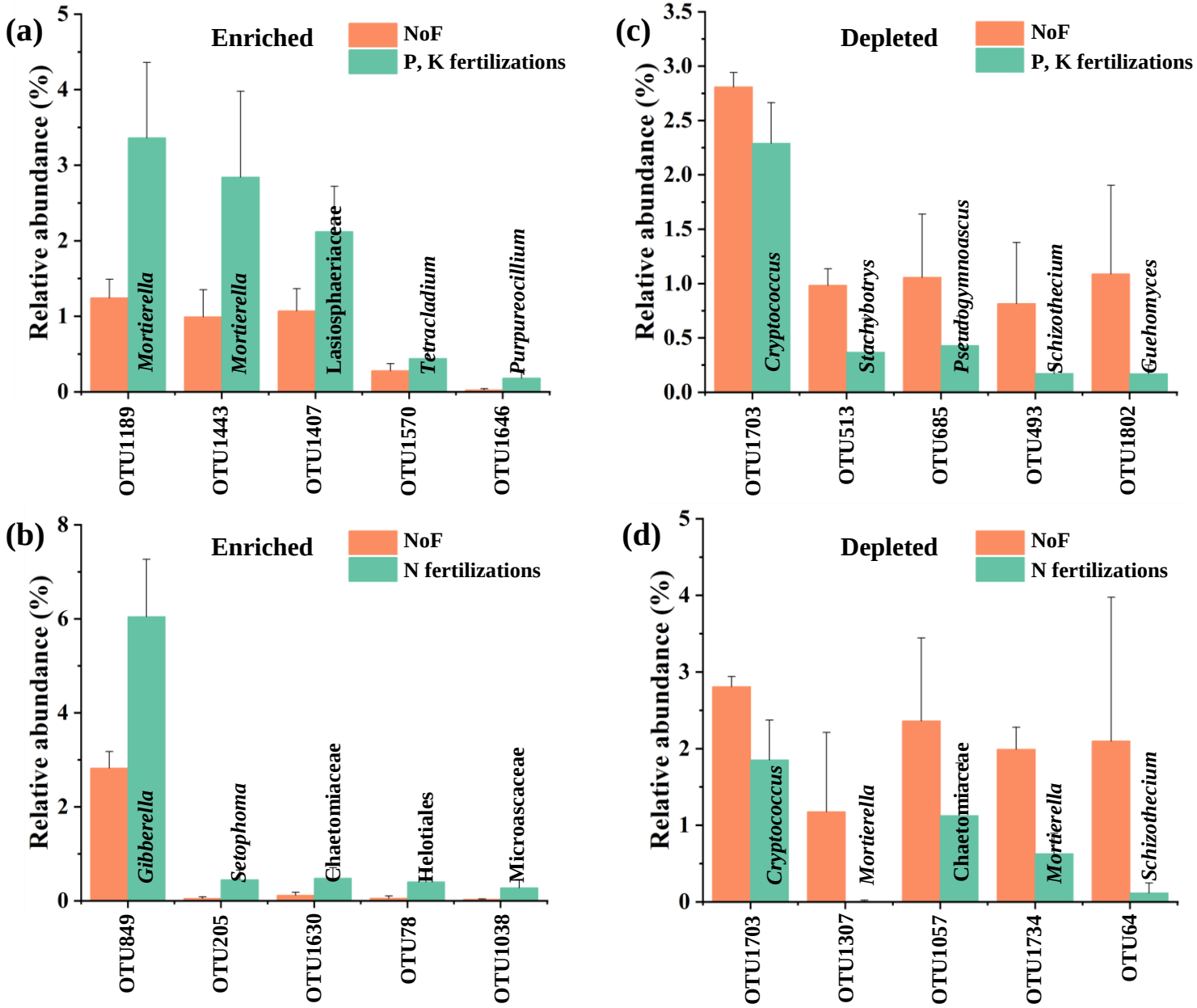


Fig. S5. The top 5 enriched (a, b) and depleted (c, d) fungal OTUs after addition of P, K fertilizers (a, c) and N fertilizers (b, d) relative to NoF. P, K fertilizations include P, K and PK fertilization treatments, and N fertilizations include N, NK, NP and NPK fertilization treatments. The fungal OTUs are identified at the genus level or higher. Bars with different letters indicate significant differences ($P < 0.05$, ANOVA).

Fig. S5

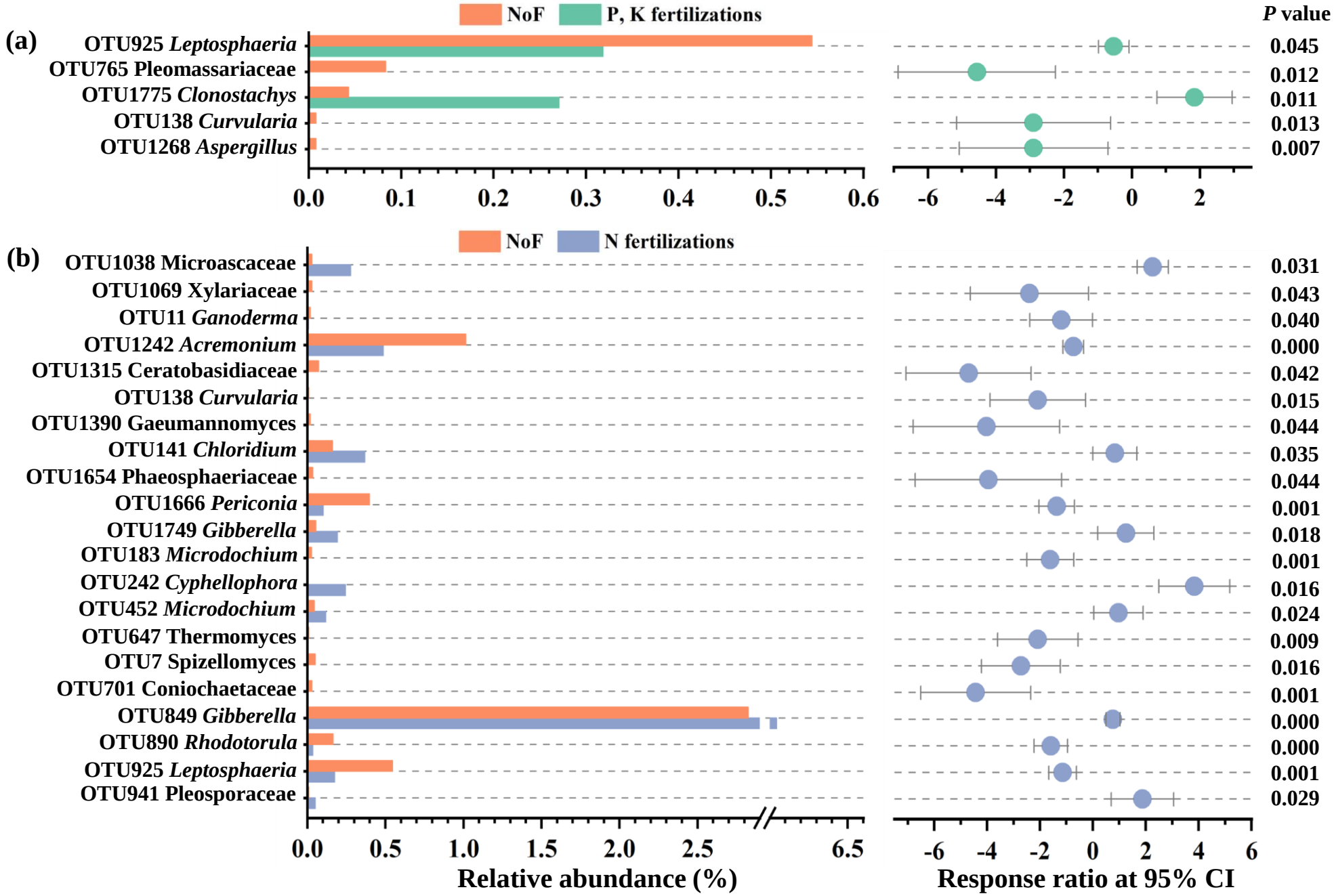
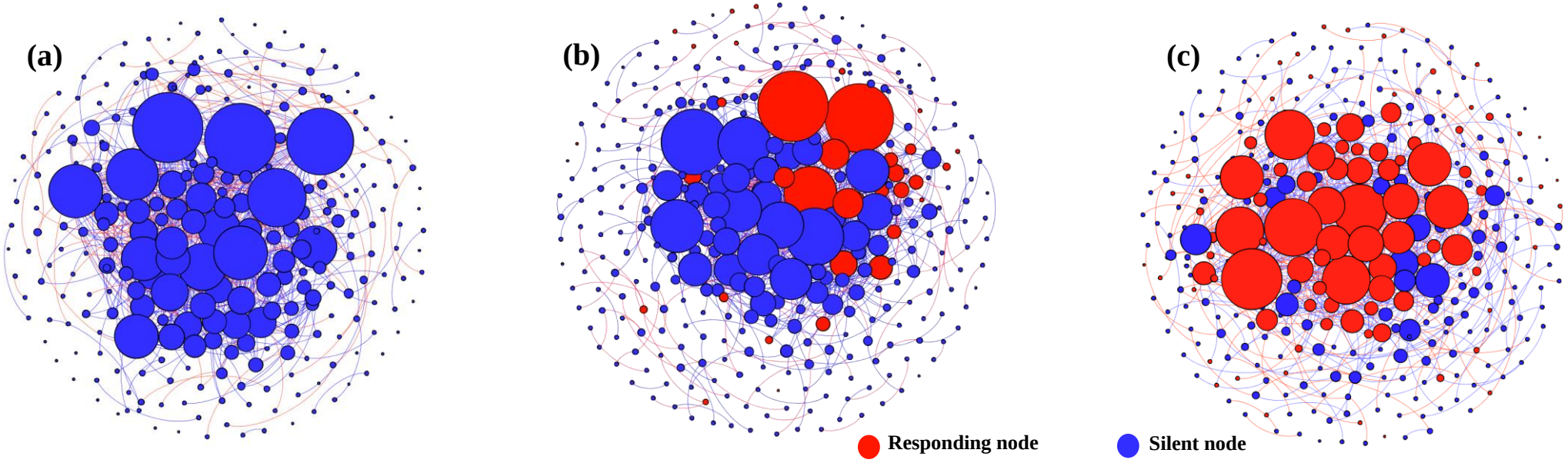


Fig. S6. Relative abundances of responding plant pathogen under P, K fertilizations (a) and N fertilizations (b) relative to NoF. P, K fertilizations include P, K and PK fertilization treatments, and N fertilizations include N, NK, NP and NPK fertilization treatments. Significance is determined using a 95% confidence interval (CI). The fungal OTUs are identified at the genus level or higher.

Fig. S6



(d)

Network parameters	NoF	P, K fertilizations	N fertilizations
Node	278	333	335
Edge	652	733	708
Positive interactions	75.2%	72.4%	69.6%
Average degree	4.691	4.402	4.227
Average clustering coefficient	0.168	0.159	0.153
Network density	0.017	0.015	0.013
Network centralization	0.136	0.114	0.099

Fig. S7. Co-occurrence network patterns visualizing the interactions among fungal OTUs under NoF (a), P, K fertilizations (b) and N fertilizations (c), relevant network parameters shown in table (c). P, K fertilizations include P, K and PK fertilization treatments, and N fertilizations include N, NK, NP and NPK fertilization treatments. Blue and red lines indicate positive and negative interactions between two individual nodes, respectively. The responding nodes are colored in red and silent nodes were colored in blue. The size of each node is proportional to its degree (*i.e.* the number of edges of a node to other nodes).

Fig. S7

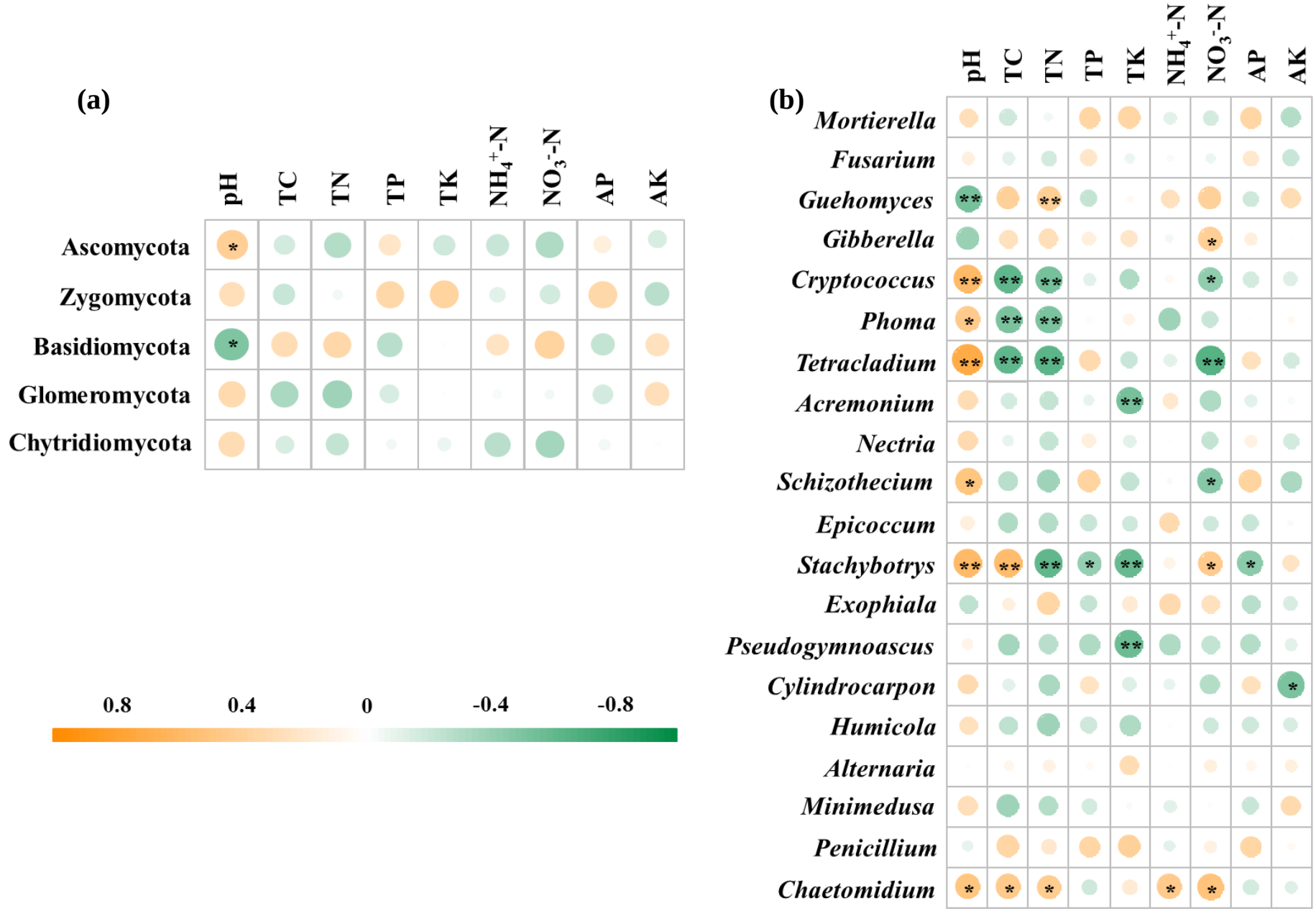


Fig. S8. Heatmap plots showing the relationships between fungal dominant phyla (a), genus (b) and soil properties. TC, soil total carbon; TN, soil total nitrogen; TP, soil total phosphorus; TK, soil total potassium; AP, soil available phosphorus; AK, soil available potassium. **, $P < 0.01$; *, $P < 0.05$.

Fig. S8

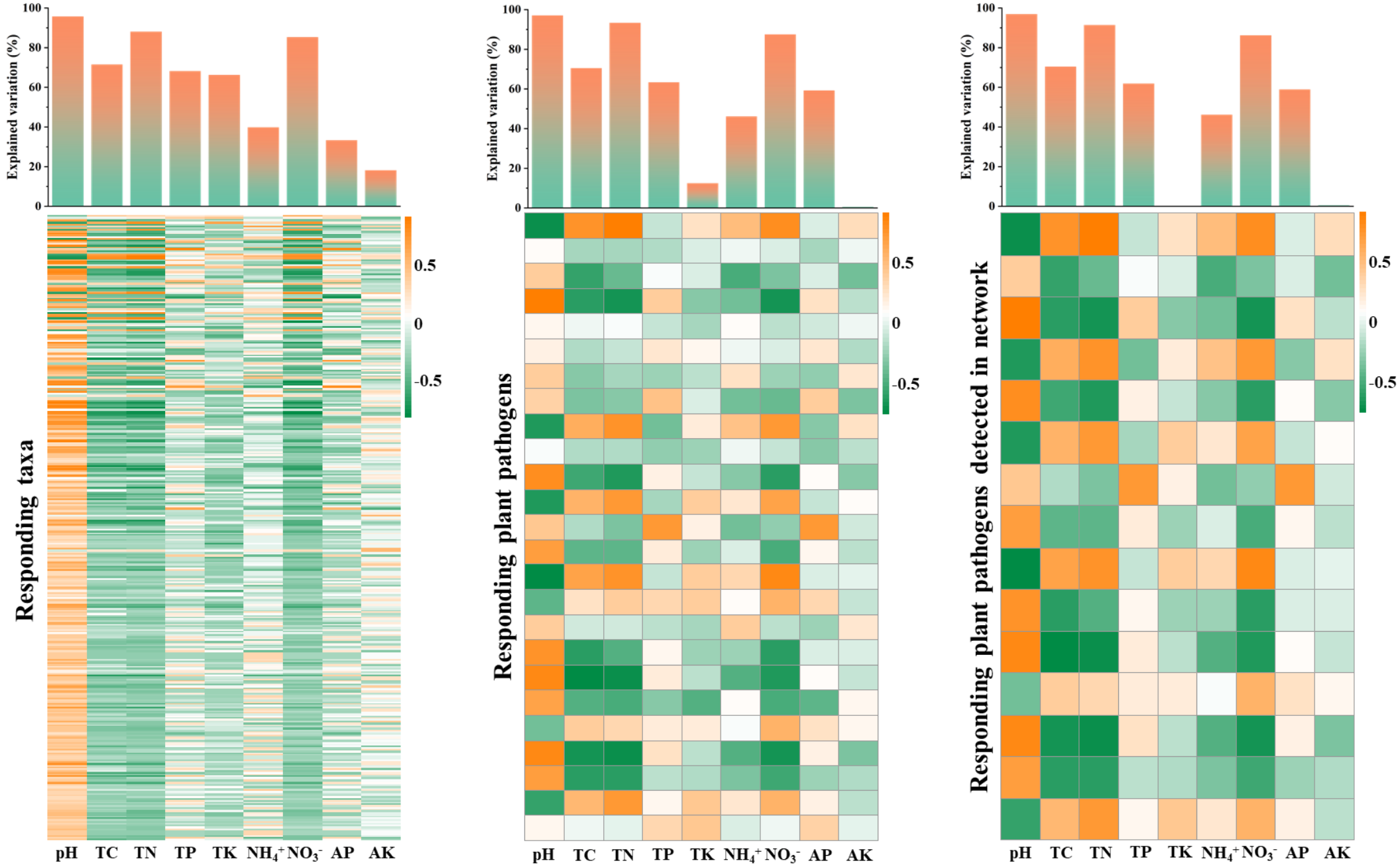


Fig. S9. Heatmap plots showing relationships between responding taxa, responding plant pathogen, responding plant pathogen detected in network and soil properties. Columns represent the variable's importance. TC, soil total carbon; TN, soil total nitrogen; TP, soil total phosphorus; TK, soil total potassium; AP, soil available phosphorus; AK, soil available potassium.

Fig. S9

Supplementary materials

Title: Highly variation of fungal communities and associated potential plant pathogens induced by long-term addition of N fertilizers rather than P, K fertilizers: a case study in a Mollisol field

Running title: Nitrogen fertilizer greatly shifts the stability of soil fungal community

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Supplementary result

Text 1. Soil properties and soybean yields

Long-term addition of N, P, K alone or their combination induced obvious shifts (ANOVA, $P < 0.05$) all soil properties examined in this study except the content of NH_4^+-N (Fig. S1). Compared to NoF, all the N fertilizations (N, NK, NP and NPK) significantly decreased soil pH with average 1.0 unit, while increased the concentrations of soil TC, TN and NO_3^--N. Although P, K fertilizations (P, K and PK) changed the above soil properties as the similar trend with N fertilizations, these variations were much slightly when compared with NoF. Additionally, compared to NoF, the contents of TP, AP and AK were obviously increased by the application of P and K fertilizers. Just

higher than that of NoF, no significant different was observed in the content of TK in fertilization treatments. The soybean yields were further calculated in sampling year. The results showed that almost all the fertilizers addition increased soybean yields when compared with NoF, but except NP (Fig. S1). Compared to NoF, both P, K fertilizations and N fertilizations significantly enhanced the yields for 25.6% and 17.6%, respectively (Fig. S2). Obviously, P, K fertilizations presented slightly higher yields than those of N fertilizations in despite of no significant difference.

Supplementary table

Table S1 Information of responding plant pathogen in subnetwork of P, K fertilizations and N fertilizations.

Fertilization	RPN	Taxa (Genus or higher)	Interaction	OTU ID	Taxa (Genus or higher)
P, K fertilizations	OTU1775	*Clonostachys*	pp	OTU1407	Lasiosphaeriaceae
			pp	OTU1420	Fungi
			pp	OTU1443	*Mortierella*
	OTU925	*Leptosphaeria*	pp	OTU1731	*Cistella*
			pp	OTU283	Hypocreales
			pp	OTU513	*Stachybotrys*
			pp	OTU701	Coniochaetaceae
			pp	OTU833	*Tetracladium*
			pp	OTU890	*Rhodotorula*
			pp	OTU897	*Pezizella*
N fertilizations	OTU1038	Microascaceae	pp	OTU1090	*Acremonium*
			np	OTU1242	*Acremonium*
			np	OTU1329	Hypocreales
			pp	OTU1348	*Penicillium*
			pp	OTU1399	Ascomycota
			pp	OTU1638	Fungi
			pp	OTU1749	*Gibberella*
			pp	OTU205	Pleosporales
			np	OTU283	Hypocreales
			pp	OTU293	Sordariomycetes
			pp	OTU312	Sordariomycetes
			pp	OTU422	Fungi
			pp	OTU514	Fungi
			pp	OTU651	Fungi
			pp	OTU745	*Phialosimplex*
			np	OTU833	*Tetracladium*
			np	OTU890	*Rhodotorula*

		np	OTU897	*Pezizella*
OTU11	*Ganoderma*	pp	OTU1548	*Mortierella*
OTU1242	*Acremonium*	pp	OTU1253	*Chaetosphaeria*
		pp	OTU1329	Hypocreales
		pp	OTU1459	Fungi
		pp	OTU1552	Coniochaetales
		pp	OTU1734	*Mortierella*
		np	OTU1749	*Gibberella*
		np	OTU205	Pleosporales
		np	OTU293	Sordariomycetes
		pp	OTU701	Coniochaetaceae
		pp	OTU721	*Mortierella*
		np	OTU745	*Phialosimplex*
		pp	OTU833	*Tetracladium*
		pp	OTU890	*Rhodotorula*
		pp	OTU897	*Pezizella*
OTU141	*Chloridium*	pp	OTU1090	*Acremonium*
		pp	OTU1233	*Pyrenochaetopsis*
		np	OTU1329	Hypocreales
		pp	OTU1348	*Penicillium*
		pp	OTU1399	Ascomycota
		np	OTU1407	Lasiosphaeriaceae
		np	OTU1420	Fungi
		pp	OTU1436	*Paecilomyces*
		np	OTU1443	*Mortierella*
		np	OTU1616	*Preussia*
		np	OTU1631	Ascomycota
		pp	OTU1638	Fungi
		np	OTU1734	*Mortierella*
		pp	OTU1749	*Gibberella*
		np	OTU259	Ascomycota
		pp	OTU383	Fungi
		pp	OTU514	Fungi
		pp	OTU530	Fungi
		pp	OTU745	*Phialosimplex*
		pp	OTU908	Ascomycota
		pp	OTU928	Acremonium
OTU1666	*Periconia*	pp	OTU1057	Chaetomiaceae
		pp	OTU1253	*Chaetosphaeria*
		pp	OTU1455	Pleosporales
		pp	OTU1459	Fungi
		pp	OTU1466	Leotiomycetes
		pp	OTU1574	*Podospora*
		pp	OTU1631	Ascomycota

		pp	OTU1691	Chaetomiaceae
		pp	OTU1731	*Cistella*
		pp	OTU1734	*Mortierella*
		np	OTU226	*Guehomyces*
		pp	OTU259	Ascomycota
		pp	OTU264	*Oidiodendron*
		pp	OTU496	Sordariales
		pp	OTU61	Ascomycota
		pp	OTU701	Coniochaetaceae
		pp	OTU770	unidentified
		pp	OTU833	*Tetracladium*
		np	OTU882	*Holtermannia*
		pp	OTU890	*Rhodotorula*
OTU1749	*Gibberella*	np	OTU1329	Hypocreales
		pp	OTU1638	Fungi
		pp	OTU25	Fungi
		pp	OTU412	Fungi
OTU183	*Microdochium*	pp	OTU1715	*Talaromyces*
OTU242	*Cyphellophora*	pp	OTU1310	*Aspergillus*
		pp	OTU1348	*Penicillium*
		pp	OTU1399	Ascomycota
		pp	OTU1630	Chaetomiaceae
		pp	OTU1638	Fungi
		np	OTU1734	*Mortierella*
		pp	OTU205	Pleosporales
		pp	OTU248	Helotiales
		np	OTU259	Ascomycota
		pp	OTU312	Sordariomycetes
		pp	OTU383	Fungi
		np	OTU954	Ascomycota
OTU7	*Spizellomyces*	pp	OTU1253	*Chaetosphaeria*
		pp	OTU1691	Chaetomiaceae
		pp	OTU1703	*Cryptococcus*
		pp	OTU1734	*Mortierella*
		pp	OTU259	Ascomycota
		pp	OTU61	Ascomycota
		pp	OTU833	*Tetracladium*
		pp	OTU890	*Rhodotorula*
OTU701	Coniochaetaceae	pp	OTU1242	*Acremonium*
		pp	OTU1631	Ascomycota
		pp	OTU1666	*Periconia*
		pp	OTU1731	*Cistella*
		pp	OTU1734	*Mortierella*
		pp	OTU259	Ascomycota

		pp	OTU264	*Oidiodendron*
		pp	OTU496	Sordariales
		pp	OTU770	Onygenales
		pp	OTU833	*Tetracladium*
		pp	OTU890	*Rhodotorula*
		pp	OTU925	*Leptosphaeria*
OTU849	*Gibberella*	pp	OTU489	Nectriaceae
OTU890	*Rhodotorula*	pp	OTU1253	*Chaetosphaeria*
		np	OTU1348	*Penicillium*
		pp	OTU1459	Fungi
		pp	OTU1574	*Podospora*
		pp	OTU1631	Ascomycota
		pp	OTU1731	*Cistella*
		pp	OTU1734	*Mortierella*
		np	OTU205	Pleosporales
		np	OTU226	*Guehomyces*
		pp	OTU259	Ascomycota
		pp	OTU283	Hypocreales
		np	OTU293	Sordariomycetes
		pp	OTU496	Sordariales
		pp	OTU61	Ascomycota
		pp	OTU721	*Mortierella*
		np	OTU745	*Phialosimplex*
		pp	OTU770	Onygenales
		pp	OTU833	*Tetracladium*
		pp	OTU897	*Pezizella*
		pp	OTU925	*Leptosphaeria*
		pp	OTU947	Fungi
OTU925	*Leptosphaeria*	pp	OTU1731	*Cistella*
		pp	OTU283	Hypocreales
		pp	OTU513	*Stachybotrys*
		pp	OTU701	Coniochaetaceae
		pp	OTU833	*Tetracladium*
		pp	OTU897	*Pezizella*
OTU941	Pleosporaceae	pp	OTU1001	Sordariomycetes

P, K fertilizations include P, K and PK fertilization treatments, and N fertilizations include N, NK, NP and NPK fertilization treatments.

RPN, responding plant pathogen detected in network

pp, positive interaction; np, negative interaction