

Effects of Fertilization Methods on Chemical Properties, Enzyme Activity, and Fungal Community Structure of Black Soil in Northeast China

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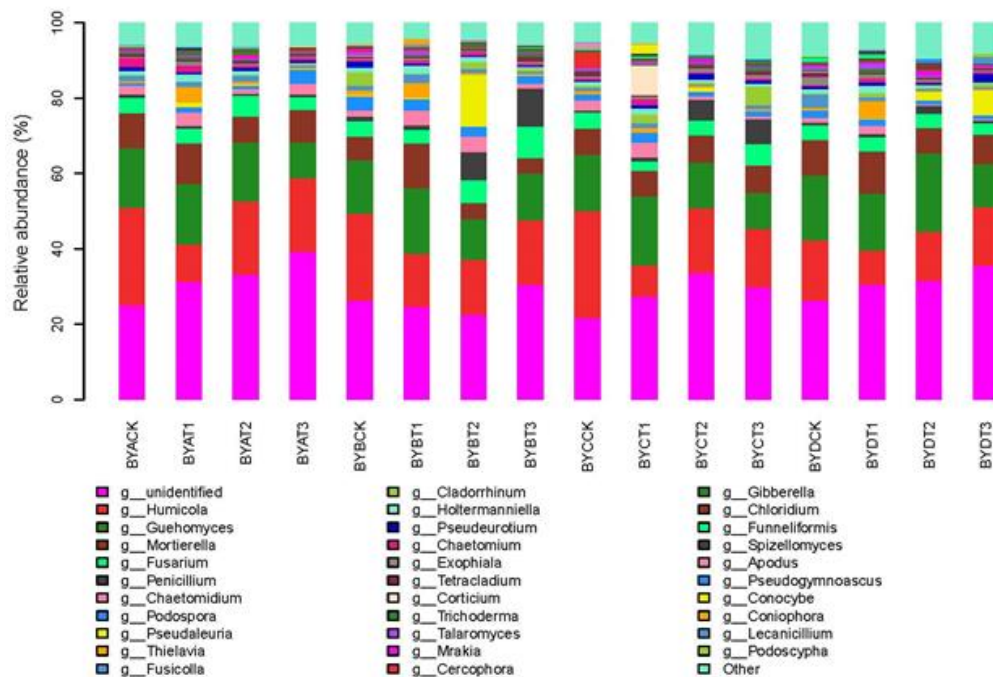


Figure 1. The relative abundance of fungal genera under different treatments and at different maize growth stages. BY indicates the sampling location in Bayan County; the middle letters A, B, C, and D represent the maize growth period of seedling, jointing, heading period and maturity; CK, T1, T2 and T3 indicate fertilization treatments of no fertilizer, bio-organic + humic acid, bio-organic + chemical, and chemical fertilizer, respectively.

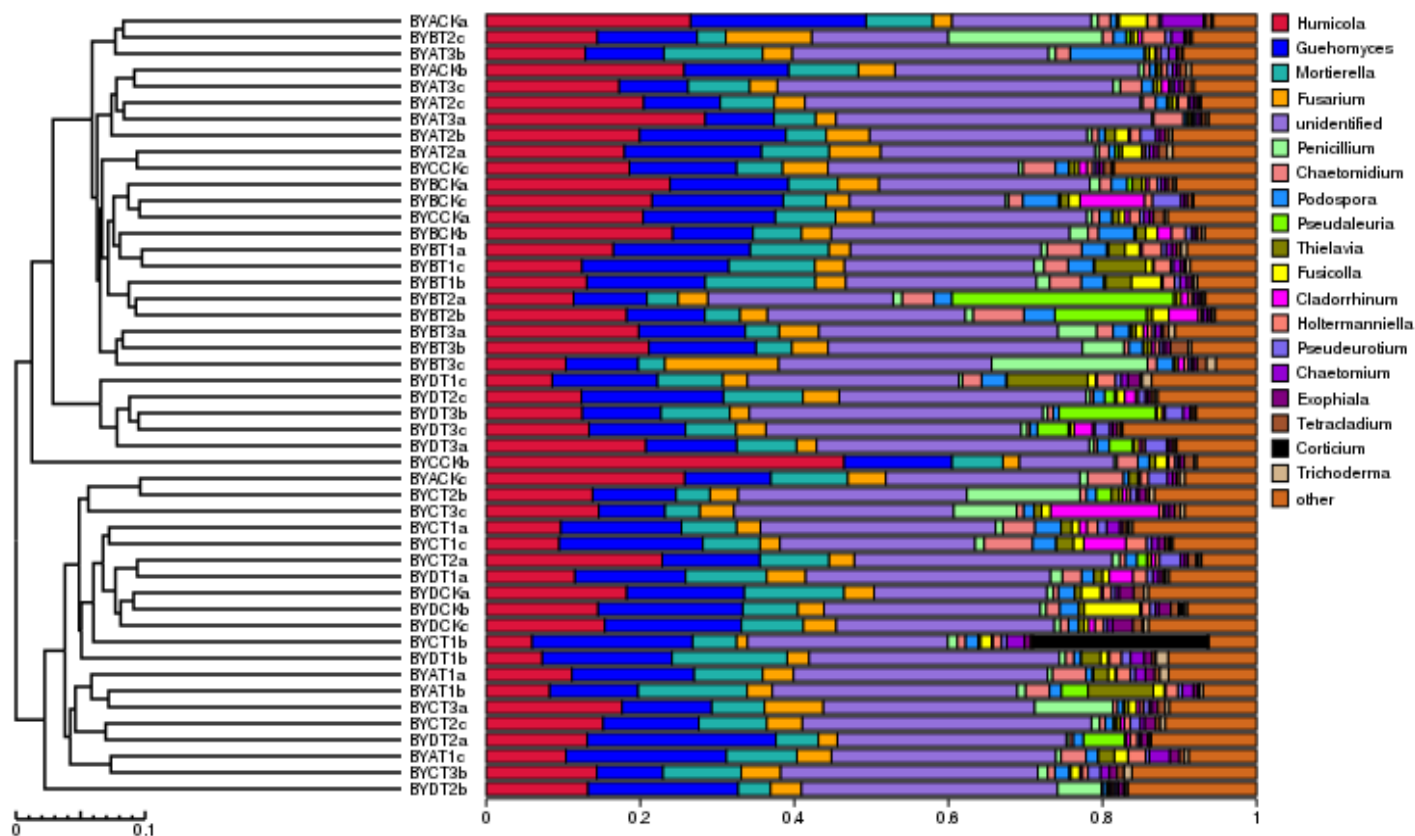


Figure 2. Phylogenetic relationships of communities shown with the relative abundance of dominant fungal genera. BY indicates the sampling location in Bayan County; the middle letters A, B, C, and D represent the maize growth period of seedling, jointing, heading period and maturity; CK, T1, T2 and T3 indicate fertilization treatments of no fertilizer, bio-organic + humic acid, bio-organic + chemical, and chemical fertilizer, receptively; the letters a, b and c indicate the three replicates.

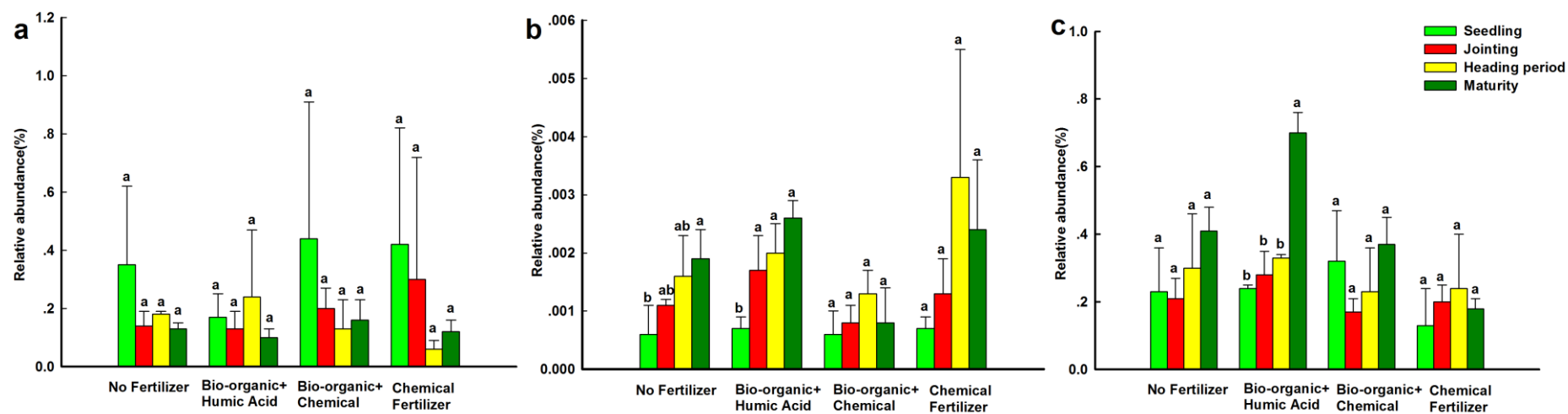


Figure 3. Seasonal changes of the relative fungal genera abundances of (a) *Mrakiella*, (b) *Coniochaeta*, and (c) *Chloridium* at the four maize growth stages. Values are mean and standard deviation ($\pm$ SD, $n = 3$). Different letters correspond to significantly different values as determined via one-way ANOVA ($P < 0.05$).

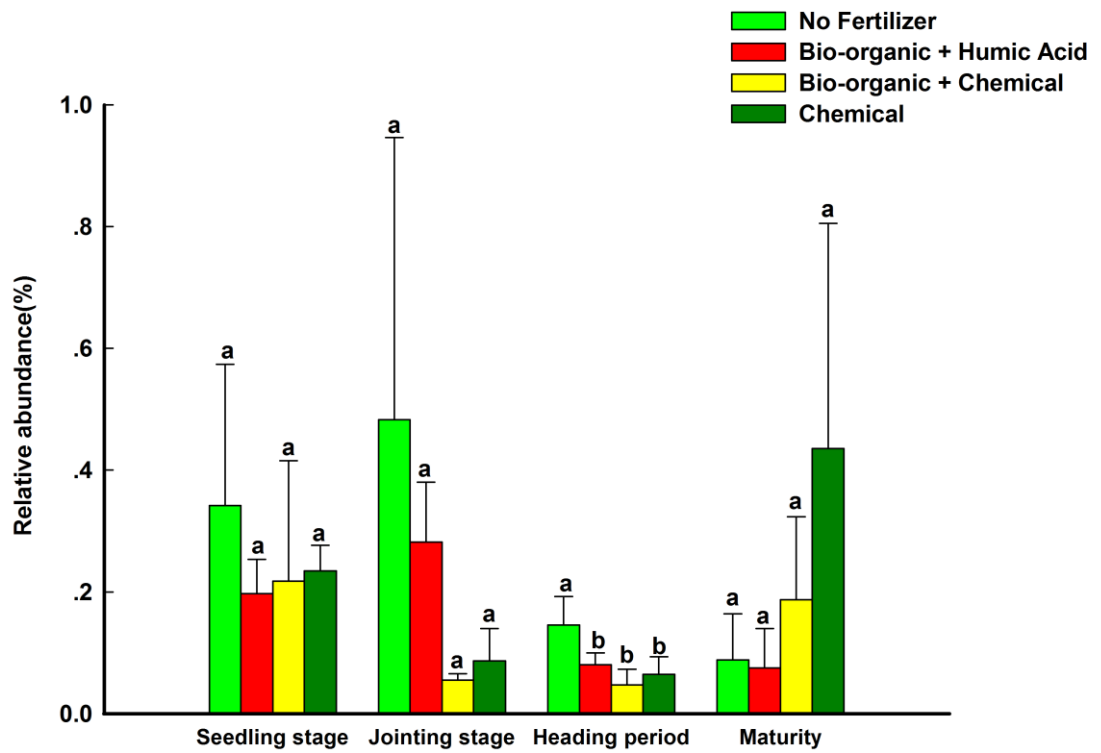


Figure 4. Effect of different fertilization methods on the relative abundances of soil pathogen *Nigrospora* at the four maize growth stages. Values are mean and standard deviation ($\pm$ SD, $n = 3$). Different letters above columns indicate significant difference among treatments tested by one-way ANOVA ($P < 0.05$).

Table 1. Relative abundance (%) of fungal phyla of all soil samples.

Period of growth	Sample	Ascomycota	Basidiomycota	Mortierellomycota	Chytridiomycota	Glomeromycota
Seedling stage	No Fertilizer	67.54±4.92a	18.77±6.40a	9.25±0.67a	0.75±0.39a	0.25±0.22a
	Bio-organic + Humic Acid	61.36±2.46a	20.70±5.30a	10.73±2.96a	2.71±1.67a	0.57±0.54a
	Bio-organic + Chemical	63.65±1.59a	19.25±6.39a	7.01±1.78a	4.36±6.21a	0.20±0.10a
	Chemical Fertilizer	66.81±6.94a	11.65±1.94a	8.75±3.77a	5.59±6.51a	0.23±0.24a
Jointing stage	No Fertilizer	70.26±5.58a	17.06±3.54ab	6.11±0.48b	2.66±2.28a	0.06±0.03a
	Bio-organic + Humic Acid	59.66±1.64b	22.44±2.79a	11.94±2.11a	1.20±0.58a	0.26±0.20a
	Bio-organic + Chemical	78.13±2.94a	13.38±3.54b	4.12±0.43b	0.94±0.35a	0.16±0.11a
	Chemical Fertilizer	71.68±5.50a	14.43±3.23b	4.18±0.63b	1.12±1.45a	0.37±0.30a
Heading period	No Fertilizer	69.67±6.60a	17.14±2.22b	6.80±0.93a	1.54±2.15a	0.54±0.38a
	Bio-organic + Humic Acid	54.15±10.30a	32.69±12.45a	6.79±0.93a	1.70±2.03a	0.69±0.32a
	Bio-organic + Chemical	69.29±2.14a	16.24±0.78ab	7.41±2.60a	1.89±2.15a	0.29±0.17a
	Chemical Fertilizer	70.29±6.16a	13.73±2.03b	7.18±2.82a	1.11±0.75a	0.45±0.47a
Maturity	No Fertilizer	61.23±3.76a	21.33±2.14ab	9.42±3.14a	0.40±0.18a	1.58±1.21a
	Bio-organic + Humic Acid	61.70±8.61a	18.91±1.90ab	11.33±3.30a	1.59±1.47a	1.27±0.97a
	Bio-organic + Chemical	65.34±4.17a	24.59±5.32a	6.69±3.21a	0.48±0.17a	0.17±0.07a
	Chemical Fertilizer	74.32±2.38a	14.42±2.81b	7.77±1.18a	0.64±0.29a	0.10±0.07a

^a Relative abundances (%) of fungal phyla of all soil samples at the sampling time in Seedling stage, Jointing stage, Heading period and Maturity; The treatment of no fertilizer, bio-organic+humic acid, bio-organic + chemical and chemical fertilizer, respectively; ^b Different letters within the same column indicate significant difference between treatments in individual sampling time tested by One-Way ANOVA ($p < 0.05$)

