

COMMUNITY STRUCTURE OF FUNGI INHABITING SELECT KBS SOILS

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INTRODUCTION

Soil fungi outweigh all other soil microbiota in both richness of species and biomass (Dixon et al., 1994; Hawksworth, 2001). They extend many functions in the soil community; they're common saprotrophs, plant symbionts, plant endophytes, and plant pathogens. They inherently possess genes encoding a wide array of degradative enzymes, and axiomatically play a dominant role in soil nutrient cycling, plant nutrition and biogeochemical cycling—including the rate-limiting step in the cycling of C (i.e. lignin deconstruction). They are also responsible for producing glomulin—a major component of soil organic matter that accounts for 27 percent of total soil C, making them a focal point for studies of soil C sequestration. The study of fungi inhabiting soils is, therefore, crucial to research in three priority areas of ecology: *biodiversity, long term ecological research and global change*. Despite their fundamental importance, however, soil fungi have—until as of late—been largely excluded from studies of soil micro-communities. Here, we examined the impact of differing agricultural land management practices at the W. K. Kellogg Biological Station in Hickory Corners, Michigan on the community structure and functional potential of the fungi inhabiting those soils.

MATERIALS AND METHODS

Soil cores (10 cm deep) from the November, 2011 KBS sampling were used in this study. Cores from six reps of T1 (conventional till, corn, wheat, soybean rotation), T2 (no till, corn, wheat, soybean rotation), T7 (mid-successional field) and the three reps of DF (a nearby, deciduous forest, representing the native ecosystem from which the other treatments evolved) were composited by treatment and then processed by extracting and pooling total community DNA from two 0.5 gram soil subsamples of each composite, performing and pooling 3 PCR amplifications of each DNA extract using primers directed at approximately 350-550 bp of the 5' 28S rDNA region. Sequencing was performed on a ROCHE 454 Junior sequencing platform. Sequence data were processed/analyzed using MOTHUR and PAST.

RICHNESS AND EVENNESS INDICES

	Taxa_S	Chao-1	Evenness_e ^H /S
T1	287 ± 113	511 ± 207	0.0359 ± 0.1240
T2	251 ± 41	458 ± 85	0.3327 ± 0.1477
T7	243 ± 52	519 ± 162	0.11459 ± 0.076
DF	331 ± 64	560 ± 77	.1682 ± 0.036

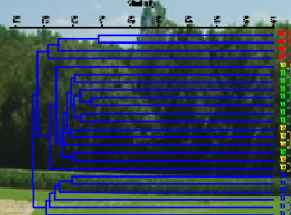
AVERAGE OF REP SAMPLES BEFORE SINGLETON REMOVAL

	Taxa_S	Chao-1	Evenness_e ^H /S
T1	205 ± 20	275 ± 23	0.3403 ± 0.05
T2	180 ± 6	246 ± 27	0.3619 ± 0.15
T7	157 ± 3	227 ± 27	0.1702 ± 0.08
DF	205 ± 9	235 ± 28	0.2214 ± 0.03

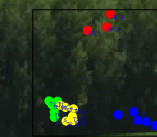
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DENDROGRAM OF TREATMENT SIMILARITY BY REP



PCoA OF ALL TREATMENTS, SINGLETONS EXCLUDED, (JACCARD)



BREAKDOWN OF KBS SOIL FUNGI BY PHYLA

401 Ascomycota
1221 Basidiomycota
165 Blastocladiomycota
488 Chytridiomycota
417 Early diverging fungal lineages
130 Glomeromycota
65 Neocallimastigomycota

	DF_1	T1_1	T2_1	T7_1
DF_1	0	0.0127	0.0138	0.0122
T1_1	0.0127	0	0.0101	0.0029
T2_1	0.0138	0.0101	0	0.0021
T7_1	0.0122	0.0029	0.0021	0

10 MOST ABUNDANT KBS SOIL FUNGI BASED ON # OF READS
 OTU 1. *Phialota* species. 1585 reads—T1=927, T2=435, T7=191, DF=32.
 Ecology: Wood-rotting saprotrophs. Note: This sequence came back to a 100% match to a lignin-degrading basidiomycete cloned from KBS soil and deposited in GENBANK by Greg Thorn. Thorn et al. (1996).

OTU 2. *Agaricales*. *Mycena (polygramma?)*. 991 reads—T1=437, T2=234, T7=166, DF=154.
 Ecology: Typically found on twigs/leaves or buried wood, the fungus is known to be a vigorous decomposer of lignin and cellulose in leaf litter.

OTU 3. *Agaricales*. *Hygrocybe (canica?)* Witches cap. 1785 reads—T1=3, T2=1, T7=1781, DF=0.
 Ecology: Saprotrophic under hardwoods or conifers; widely distributed in North America. It may be facultatively symbiotic with mosses.

OTU 4. *Mortierella (elongata?)*. 1613 reads—T1=619, T2=377, T7=245, DF=189.
 Ecology: Saprotrophs in soil, on decaying leaves and other organic material. *Mortierella* species belong to an ecology group which are the first organisms growing on roots.

OTU 5. *Agaricales (Canocybe spp?)*. 1443 reads—T1=0, T2=1422, T7=10, DF=0.
 Ecology: Saprotrophs, growing scattered or gregariously in grassy areas (lawns, meadows, pastures); widely distributed in North America.

OTU 6. *Hygrocybe* species. 1412 reads—T1=0, T2=4, T7=1406, DF=2.
 Ecology: Saprotrophic under hardwoods or conifers; widely distributed in North America. They may be symbiotically associated with mosses.

OTU 7. *Agaricales (Hygrophoraceae spp?)*. 1170 reads—T1=29, T2=8, T7=354, DF=779.
 Ecology: Saprotrophic under hardwoods or conifers.

OTU 8. *Agaricales*. 709 reads—T1=396, T2=186, T7=108, DF=19.
 Ecology: Not determined due to lack of depth of taxonomic assessment. Agarics can be mycorrhizal, saprotrophic, parasitic, pathogenic, etc.

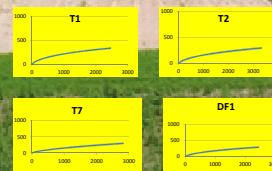
OTU 9. *Lentinula edodes*. Shiitake. 893 reads. Only found in T7-2.
 Ecology: Saprotrophic on wood. Non-native to North America. Never noted from soils before.

OTU 10. *Tricholomataceae (Laccaria spp.)* 888 reads—only found in DF-1 and DF-2.
 Ecology: Mycorrhizal with hardwoods or conifers; widely distributed in North America

SHIIT WHAT???

The cultivation of shiitake mushrooms (*Lentinula edodes*) has become very popular in North America during the last decade. It is, perhaps, not so surprising then that we discovered a patch of shiitake in T7, R2. This is, to the best of our knowledge, the first report of shiitake growing in North American soil.

RAREFACTION CURVES



One-way ANOSIM using Jaccard algorithm

PCoA OF T1 AND T2, SINGLETONS EXCLUDED, (JACCARD)



	T1_1	T2_1
T1_1	0	0.0098
T2_1	0.0098	0

One-way ANOSIM using Jaccard algorithm

VENN DIAGRAM OF T1 AND T2



VENN DIAGRAM OF T1, T2 AND DF



Results and Conclusions

We surprisingly found that the differing land management practices did not have a very consequential affect on the *overall* species richness of fungi inhabiting various KBS soils.

Land management did, however, impose a profound shift on the community structure of the fungal communities.

The saprotrophic community members of the soil fungi were richer than any other ecological groups in all treatments. Mycorrhizal species were second in richness.

Basidiomycetes, many of which being saprotrophic, were highest in both terms of richness and abundance, outnumbering the second Phyla, the Ascomycetes, by a factor of three.

The presence of *Lentinula edodes*, i.e. Shiitake, in KBS soils was surprising, and underscores the need understanding the ecological consequences of introducing foreign species for domestic cultivation.

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