TITLE:

Data from: Microbial substrate preference and community dynamics during the decomposition of Acer saccharum

AUTHORS:

Zachary L. Rinkes

Dept. of Environmental Sciences

University of Toledo

2801 W. Bancroft St.

Mail Stop 604

Toledo, OH 43606

Michael N. Weintraub

Dept. of Environmental Sciences

University of Toledo

2801 W. Bancroft St.

Mail Stop 604

Toledo OH 43606

419.530.2585

<http://www.utoledo.edu/nsm/envsciences/faculty/weintraub.html> michael.weintraub@utoledo.edu

Jared L. Deforest

Dept. of Environmental and Plant Biology

Ohio University

Porter Hall 315

Athens OH 45701

740 593 0742

<http://www.plantbio.ohiou.edu/index.php/directory/faculty_page/jared_deforest/>

http://www.ohio.edu/plantbio/staff/deforest/soils/

Daryl L. Moorhead

Dept. of Environmental Sciences

University of Toledo

2801 W. Bancroft St.

Mail Stop 604

Toledo, OH 43606

(419) 530-2017

<http://www.utoledo.edu/nsm/envsciences/faculty/weintraub.html>

FUNDING SOURCE AND GRANT NUMBER:

National Science Foundation, Ecosystem Program

Award # 0918718

PHYSICAL LOCATION:

Stranahan Arboretum, Toledo, Ohio

Latitude: 41.70

Longitude: -83.67

Southview Savannah, Oak Openings Region, Sylvania, Ohio

Latitude: 42.12

Longitude: -84.18

DATA SET OVERVIEW:

This data set contributes information on soil enzyme activities; extractable nitrogen and phosphate; microbial biomass; soil respiration; and microbial community composition through phospholipid-derived fatty acids (PLFA). Data were collected from a 500 day incubation experiment including two treatments: litter addition and no-litter. Six replicates of twenty litter addition groups and six no-litter groups were incubated and harvested at different times during the course of the experiment.

BACKGROUND:

<http://www.eeescience.utoledo.edu/Faculty/weintraub/Projects.htm>

SAMPLE COLLECTION:

*Litter and Soil Collection*: Freshly senesced sugar maple (*Acer saccharum)* leaf litter was collected weekly from Stranahan Arboretum in Toledo, Ohio using litter traps in the fall of 2008. Litter was air-dried and kept at constant humidity until incubation. Litter was ground into a fine powder using a Wiley Mill (20 mesh). Approximately 10 kg of soil were collected in September of 2008 from Southview Savanna, a portion of the Oak Openings region, in Sylvania, Ohio. Each soil core was collected using a metal soil corer with a diameter of 5 cm to a depth of 5 cm from a 30 m² area. Soils were then taken immediately back to the lab and sieved (2 mm mesh) to remove coarse debris and organic matter and then homogenized by hand. Soil was stored under pre-incubation conditions (i.e. field moisture) for 5 months then under incubation conditions of 40% water holding capacity and 20 °C for 20 days. For more information, see Rinkes *et al*. (2011).

*Incubation*: Two soil treatments (litter addition and no-litter) were incubated in 0.237 L Mason jars (Ball Half Pint Wide Mouth Canning Jars, Jarden Corporation) with lid and septa. Litter addition jars received 28 g of soil (dry weight equivalent) at 40% water holding capacity and 3 g of ground litter (dry weight equivalent). No-litter jars received only 28 g of soil (dry weight equivalent) at 40% water holding capacity. Six replicates of twenty litter addition groups and six no-litter groups were incubated and harvested at different times during the course of the experiment. Jars were kept loosely covered (to minimize water loss, but allow gas exchange) in a dark incubator at 20 °C throughout the 500 day incubation. Water holding capacity was gravimetrically adjusted on a weekly basis to 40% water holding capacity. Litter addition jars were destructively harvested after 0, 1, 2, 5, 8, 12, 16, 20, 25, 33, 41, 49, 56, 68, 83, 111, 154, 210, 363, and 500 days of incubation. No-litter jars were destructively harvested after 0, 2, 25, 68, 210, and 500 days of incubation. Jars were harvested for soil enzyme activities; extractable nitrogen and phosphate; and microbial community analysis (see below for descriptions). During harvests, soils were extracted with 0.5 M potassium sulfate (K₂SO₄). Extractions were performed by placing samples on an orbital shaker at ~120 rpm for 1 hour, and then vacuum filtering the mixture through Millipore APM 15 glass fiber filters. These extracts are labeled as non-fumigated.

Samples were also harvested for microbial biomass. Microbial biomass carbon (MB-C) was quantified using a modification of the chloroform fumigation-extraction technique (Brookes et al. 1985; Scott-Denton et al. 2006). Following chloroform fumigation, soils were extracted as described above. These extracts are labeled as fumigated. Fumigated and non-fumigated extracts were then frozen until time of analysis. For more information, see Rinkes *et al*. (2011).

DATA COLLECTION:

*Soil Nutrients*: Soil nutrients were analyzed using non-fumigated soil samples. Nitrogen analyses included nitrate and ammonium. Nitrate was analyzed using the method described by Doane & Horwath (2003). Final nitrate values are reported in μg NO3⁻ g-1 dry soil. Ammonium was analyzed using the method described by Rhine *et al*. (1998). Final ammonium values are reported in μg NH4+ g-1 dry soil. Phosphate analysis was conducted using the method described by D’Angelo *et al*. (2001). Final phosphate values are reported in μg PO43- g-1 dry soil.

*Microbial Biomass*: Microbial biomass C was analyzed using fumigated and non-fumigated soil extracts. Samples were analyzed for dissolved organic carbon (DOC) using a Shimadzu total organic carbon (TOC-VCPN) analyzer (Shimadzu Scientific Instruments Inc., Columbia, MD, USA). Microbial biomass was calculated by subtracting non-fumigated sample concentrations of total organic carbon from fumigated sample concentrations of carbon. Final values are reported in μg C g-1 dry soil. For more information, see Rinkes *et al*. (2011).

*Soil Enzyme Activities*: Hydrolytic and oxidative extracellular enzyme activities were analyzed. Samples were analyzed for β-glucosidase (BG), N-acetyl-β-glucosaminidase (NAG), leucine amino peptidase (LAP), acid phosphatase (PHOS), peroxidase (PEROX) and phenol oxidase (PHENOX). BG produces glucose from the hydrolysis of cellulose oligomers; NAG, a chitinase, produces N-acetyl glucosamine from the hydrolysis of chitin derived oligomers; LAP produces leucine and other amino acids from the hydrolysis of peptides; PHOS produces phosphate from the hydrolysis of phosphate monoesters such as sugar phosphates; PEROX and PHENOX are oxidative enzymes involved in lignin degradation. Hydrolytic enzyme activities (BG, NAG, PHOS and LAP) were analyzed using the fluorometric assay described by Saiya-Cork *et al*. (2002). Oxidative enzymes (PHENOX and PEROX) were analyzed using the colorimetric assay described by Saiya-Cork *et al*. (2002).

*Respiration Analysis*: Litter addition and no-litter jars were vented for two minutes and then tightly sealed and incubated at 20°C for approximately 1-4 hours. Respiration was measured by injecting gas samples collected from the headspace of each jar into a Li-820 Infra-Red Gas Analyzer (LI-COR Biosciences, Lincoln, Nebraska, USA) setup for static gas injections. Final respiration values are reported in μg C g-1 dry soil day-1. For more information, see Rinkes *et al*. (2011).

*Phospholipid-derived fatty acid (PLFA) analysis*: PLFA analysis was conducted on samples taken from destructive harvests after 2, 5, 25, 68, and 363 days of incubation for litter addition and 2, 25, and 210 days of incubation for no-litter jars. Six samples were taken from each harvest and immediately frozen and then freeze-dried within a week of harvest. Three of the six samples from each harvest were randomly selected for PLFA analysis. For more information, see Rinkes *et al*. (2011).

NAMING CONVENTIONS:

The following refer to headers or terms used in the data spreadsheets:

*General definitions:*

day: day of incubation when measurements occurred

replicate: replicate number (n=6)

treatment: sugar maple + sand (litter) or sand only (no-litter)

blank cells=no data available; cell value = 0 means no activity

*Harvests:*

BG: Beta glucosidase activity, nmol hr-1 g-1 soil (fluorescent enzyme assay protocol)

NAG: N-acetyl-beta-glucosaminidase activity, nmol hr-1 g-1 soil (fluorescent enzyme assay protocol)

LAP: Leucine aminopeptidase activity, nmol hr-1 g-1 soil (fluorescent enzyme assay protocol)

PHOS: Phosphatase activity, nmol hr-1 g-1 soil (fluorescent enzyme assay protocol)

PEROX: Peroxidase activity (DOPA as substrate). µmol g-1 soil hr-1 (colorimetric microplate protocol), Net Peroxidase reported (Perox-Phenox)

PHENOX: Phenol oxidase activity (DOPA as substrate). µmol g-1 soil hr-1 (colorimetric microplate protocol)

NH4: µg NH4-N g-1 soil from 0.5M K2SO4 extractions using microplate assay

NO3: µg NO3-N g-1 soil from 0.5M K2SO4 extractions using microplate assay

PO4: µg PO4-P g-1 soil from 0.5M K2SO4 extractions using microplate assay

MBC: microbial biomass C, ug C g-1 soil, measured in K2SO4 extract on Shimadzu analyzer

TOC: Total dissolved organic C, ug C g-1 soil, measured in K2SO4 extract on Shimadzu analyzer

*Respiration*

CO2: µg C g-1 soil day-1 (measured using IRGA with static injection method; incubation time varied based on stage of decay)

Litter treatments: 28 g soil + 3 g litter on day 0

No-litter: 28 g soil

*PLFA-biomass* (PLFA conducted in the lab of Dr. Jared DeForest, Ohio University)

Biomass: nmol PLFA C/g -1

F/B ratio: ratio of fungi:bacteria based on specific biomarkers (indicated in cell)

PLFA biomarkers are found in columns E through BQ: indicate biomass of specific PLFA biomarker

*PLFA-mol fraction*

PLFA biomarkers are found in columns E through BQ: indicate % of total biomass for each specific PLFA biomarker

LINKS:

<http://www.eeescience.utoledo.edu/Faculty/weintraub/Projects.htm>

REFERENCES:

Brookes, P.C., Landman, A., Pruden, G., Jenkinson, D.S., 1985. Chloroform fumigation

and the release of soil nitrogen: a rapid direct extraction method to measure

microbial biomass nitrogen in soil. Soil Biology & Biochemistry 17, 837e842.

D'Angelo, E., Crutchfield, J., Vandiviere, M., 2001. Rapid, sensitive, microscale determination of phosphate in water and soil. J. Environ. Qual. 30, 2206-2209.

Doane, T.A., Horwath, W.R., 2003. Spectrophotometric determination of nitrate with a single reagent. Analytical Letters 36, 2713-2722.

Rhine, E.D., Sims, G.K., Mulvaney, R.L., Pratt, E.J., 1998. Improving the berthelot reaction for determining ammonium in soil extracts and water. Soil Sci Soc Am J 62, 473-480

Rinkes, Z. L., Weintraub, M. N., DeForest, J. L., & Moorhead, D. L. 2011. Microbial substrate preference and community dynamics during decomposition of< i> Acer saccharum</i>. *Fungal Ecology*, *4*(6), 396-407.

Saiya-Cork KR, Sinsabaugh RL, Zak DR, 2002. The effects of long term nitrogen deposition on extracellular enzyme activity in an Acer saccharum forest soil. Soil Biology and Biochemistry 34: 1309e1315.

Scott-Denton, L.E., Rosenstiel, T.N., Monson, R.K., 2006. Differential controls by climate and substrate over the heterotrophic and rhizospheric components of soil respiration. Global Change Biology 12, 205-216.