College of Agricultural, Consumer and Environmental Sciences

Compost as Microbial Inoculant

Amy Larsen, Robert Heyduck, Steven Guldan
NMSU Sustainable Agriculture Science Center at Alcalde, NM

All About Discovery!™
New Mexico State University

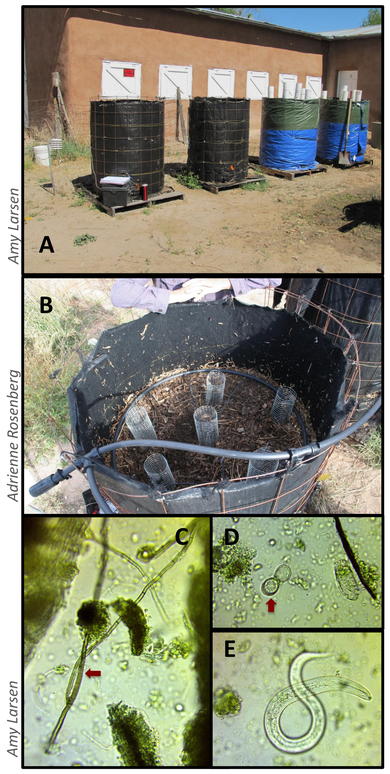
Introduction and Objective

Reversing the depletion of our soil's organic matter and biodiversity has become an issue of concern worldwide. The 2015 United Nations report, *"Status of the World's Soil Resources"*[1] lists erosion and decreased soil biodiversity as major threats to North American soils, based on area of land affected. Phase I of this study seeks to understand how compost might play a role in cultivating diverse sets of microbial communities. Phase II, commencing in the spring of 2019, will examine whether compost microbes might augment depleted soil microbial communities.

OBJECTIVE: This study used the Johnson-Su Composting System[2] (a static, aerobic process) and will assess two compost recipes in terms of their effectiveness in producing microbially diverse compost after a 9-12 month curing phase.

Materials and Methods

- Approximately one cubic yard of compost materials was mixed, well saturated in water, and added to a wire frame cage, with vertical ventilation columns to ensure adequate passive aerobic diffusion into the pile.
- Two compost recipes were replicated twice, resulting in four compost bins. Recipe 1 contained more C-rich material; Recipe 2 had more N-rich material, by volume.
- Compost will mature over 9-12 months in a static, unturned state. Moisture is maintained by regular watering.
- Dataloggers continually record compost temperatures at two locations within each pile.
- Compost samples were analyzed for baseline quality characteristics, including nutrient and microbial analyses.



A) 4 Johnson-Su Composting Bioreactors, 2 Compost Recipes; B) Compost Irrigation & Aeration; C) Fungi; D) Amoeba Dividing; E) Nematode *(All microscope images at 400x magnification. Microbes found in compost)*

RECIPE 1 COMPOST MATERIALS

	Carbon-rich Material (ft^3)	Nitrogen-rich Material (ft^3)
Organic Alfalfa Hay		2.7
Fruit & Vegetable Waste		1.7
Organic Heat-Treated Chicken Manure		0.5
Organic Aged Dairy Manure		0.5
Aged Wood Chips (Deciduous & Conifer)	17.0	
Dry Brown Leaves	4.0	
Ramial Chipped Wood (Fruit Trees)	4.0	
Subtotal of Material Amounts (ft^3):	25.0	5.4
Percentage of Total by Volume:	82.2%	17.8%
Total Volume (yd^3):	**1.13**	

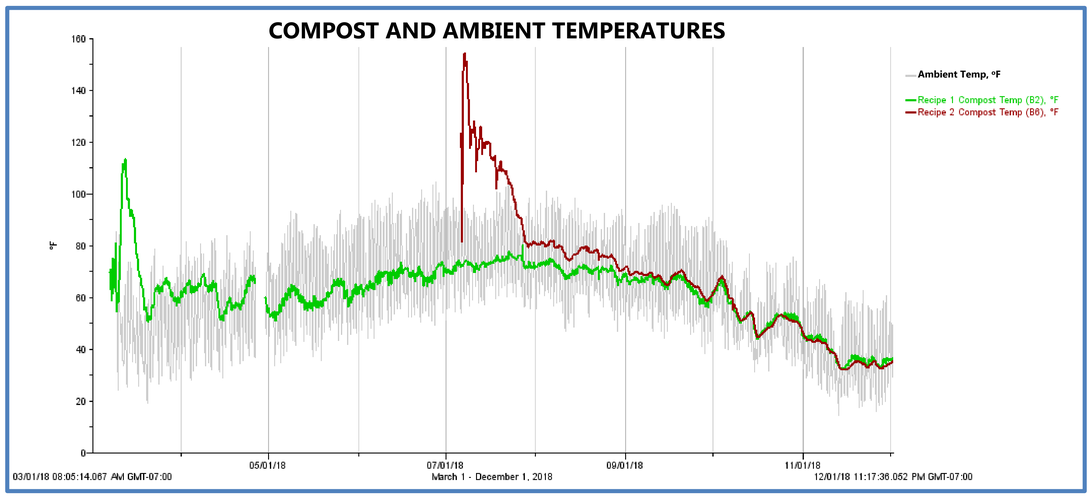
Volume data are an average of 2 compost piles. Piles were built on 3/9/18.

RECIPE 2 COMPOST MATERIALS

	Carbon-rich Material (ft^3)	Nitrogen-rich Material (ft^3)
Organic Alfalfa Hay		2.7
Horse Manure		12.0
Chicken Coop Bedding (Straw & Manure)	0.9	0.5
Dry Barley Grain		0.5
Aged Wood Chips (Deciduous & Conifer)	5.5	
Dry Brown Leaves	4.0	
Subtotal of Material Amounts (ft^3):	10.3	15.7
Percentage of Total by Volume:	39.7%	60.3%
Total Volume (yd^3):	**0.96**	

Volume data are an average of 2 compost piles. Piles were built on 7/6/18.

Results



COMPOST QUALITY INDICATORS

QUALITY INDICATORS	RECIPE 1 60 days	RECIPE 1 196 days	RECIPE 1 256 days	RECIPE 2 7 days	RECIPE 2 94 days	RECIPE 2 138 days
C:N	38†		24.7*	31†		13.2*
Fungal:Bacterial Biomass Ratio		0.228	0.259		0.223	0.045
Fungi µg/g		344	324		228	242
Bacteria µg/g		1507	1247		1023	5386
MICROFAUNA (#/g):						
Flagellates (x 10^3)		141	105		73	118
Amoebae (x 10^3)		188	1518		386	2011
Nematodes		160	96		384	128
Ciliates & Rotifers		128	160		160	0

Data values are an average of 2 replications. †Data provided by SoilTest Farm Consultan Laboratories, Inc. All other data provided by NMSU SASC at Alcalde using Soil Foodweb, Inc.[3] direct microscopy methodology.

Discussion

The composition of compost materials will determine the initial C:N ratio of a given pile, but that ratio will change as microbes decompose organic matter, converting carbon and nitrogen into microbial biomass and other forms. Rapid decomposition and microbial reproduction release energy in the form of heat. The initial spike in compost temperature subsequently decreases to median ambient temperature as nitrogen is consumed and microbial activity slows. Recipe 2 displays a longer active heating cycle than Recipe 1, likely due to more nitrogen-rich materials in the mix.

Fungi and bacteria form the foundation of the food chain and perform much of the work of breaking down organic matter. Microfauna prey on fungi, bacteria and other microbes.

Microbial community composition changes as the pile ages, and the rates of change may be related to compost feedstocks. In Recipe 1, the F:B ratio increased even though both fungal and bacterial biomass decreased. In contrast, the F:B ratio of Recipe 2 decreased significantly because bacterial populations increased over 500%. Recipe 1 and 2 show an eightfold and fivefold increase in amoeba populations, respectively, while nematode populations decreased. Flagellate, ciliate and rotifer populations varied between the two recipes.

Contact and References

Amy Larsen Email: amlarsen@nmsu.edu | NMSU SASC at Alcalde Webpage: alcaldesc.nmsu.edu

1. FAO and ITPS. 2015. Status of the World's Soil Resources (SWSR) – Main Report. Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy (p. 454 – 459).
2. NMSU College of Agricultural, Consumer and Environmental Sciences. June 2017. Best Management Practices: Johnson-Su Composting Bioreactors.
3. Soil Foodweb, Inc. Foundation Course #4 Microscopy. www.soilfoodweb.com.