NORTH CENTRAL SARE
Sustainable Agriculture Research & Education

SARE/ATTRA OUR FARMS, OUR FUTURE

SARE PROJECT GNC17-250

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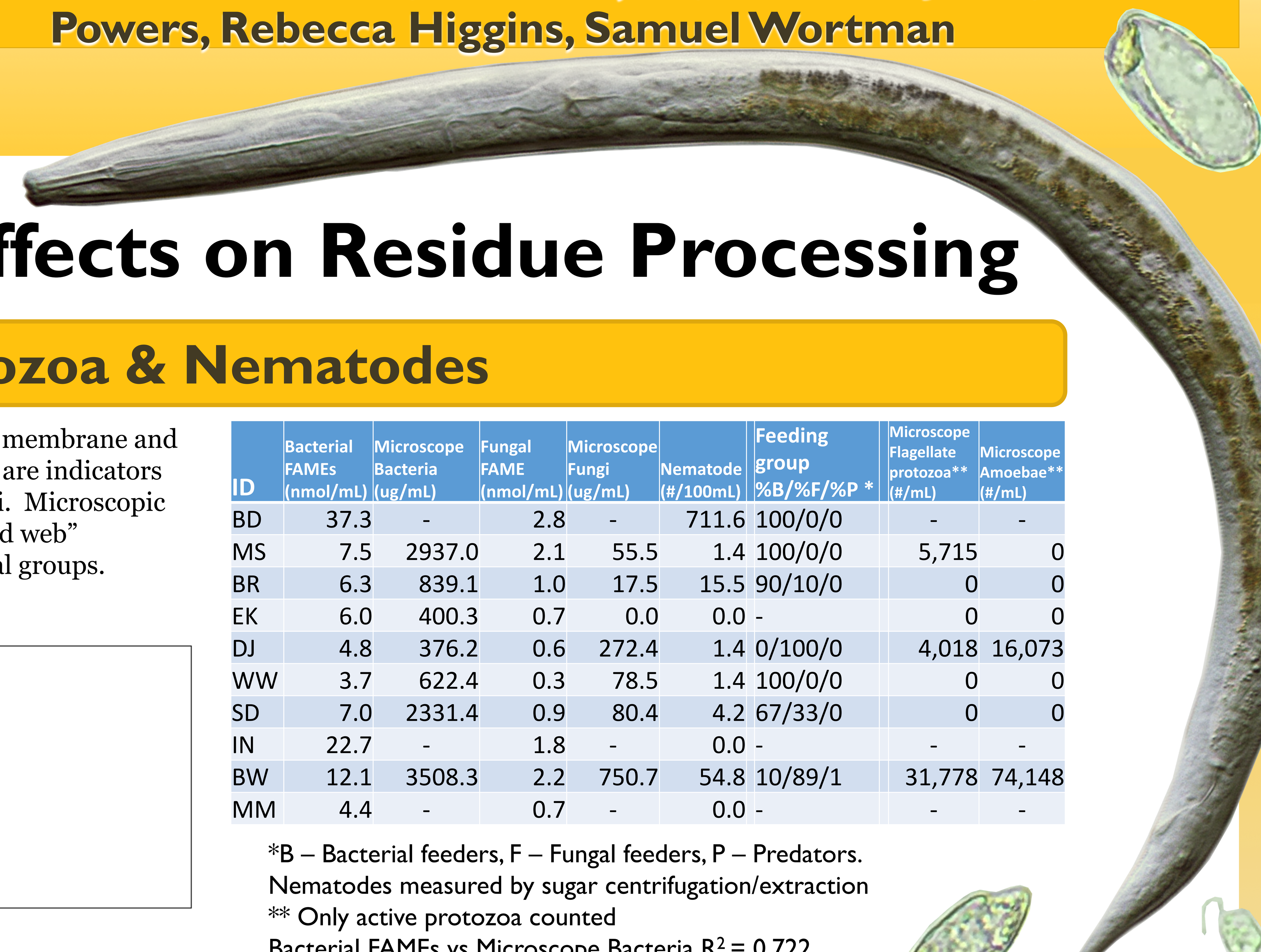


Biological Properties of Compost Extracts and Effects on Residue Processing

Introduction

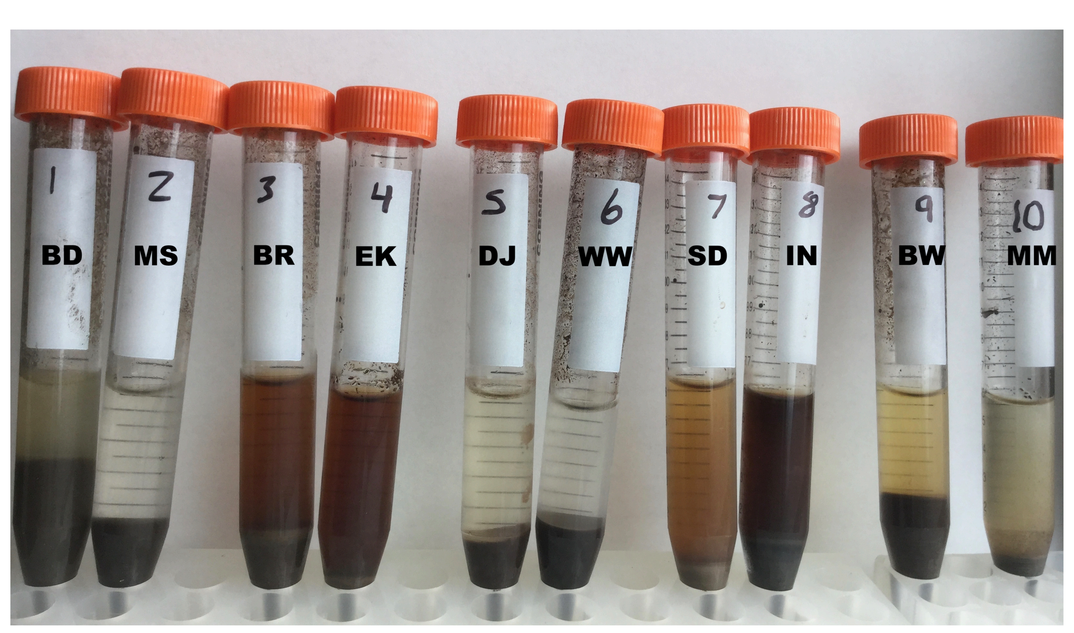
Use of compost involves the import of a diversity of potentially soil-inhabiting organisms into agricultural systems. Compost extracts (CE) are small amounts of compost suspended in water. Anecdotes and practitioner experience suggests that CE may function as meaningful inoculum, accelerating residue degradation and nutrient cycling. However, composts are highly variable and their extracts are expected to have similar microbial variation. The goals of this project are:

- To characterize biological and chemical properties of diverse compost extracts and define ranges of potentially meaningful dimensions.
- To determine whether compost extracts can affect residue processing in soil.

Composts selected for diversity of feedstock & origin

ID	Compost	Type	Feedstock
BD	Biosolids	Class B Biosolids*	Anaerobicallly digested biosolids
MS	NPL Mushroom	Bagged	Spent mushroom media
BR	Big Red Worms	Local / Worm	Kitchen scraps, yard waste
EK	EKO	Bagged	Chicken bedding, wood
DJ	D. Johnson	Passive Aerated Static / Worm	Yard waste, cow manure
WW	Wiggle Worm	Bagged / Worm	Organic grain
SD	Soil Dynamics	Local Windrow	Yard waste, zoo poo, kitchen scraps
IN	ACN Innwood	Feedlot Windrow*	Corn stover, cow manure
BW	Backyard Worm	Home Compost / Worm	Kitchen scraps, leaves, wood
MM	Mountain Magic	Bagged	Forest byproducts, cow manure

* "Immature" composts - Based on NH_4^+ concentration, respiration after drying and rewetting, and compost extract suppression of lettuce germination (data not shown).



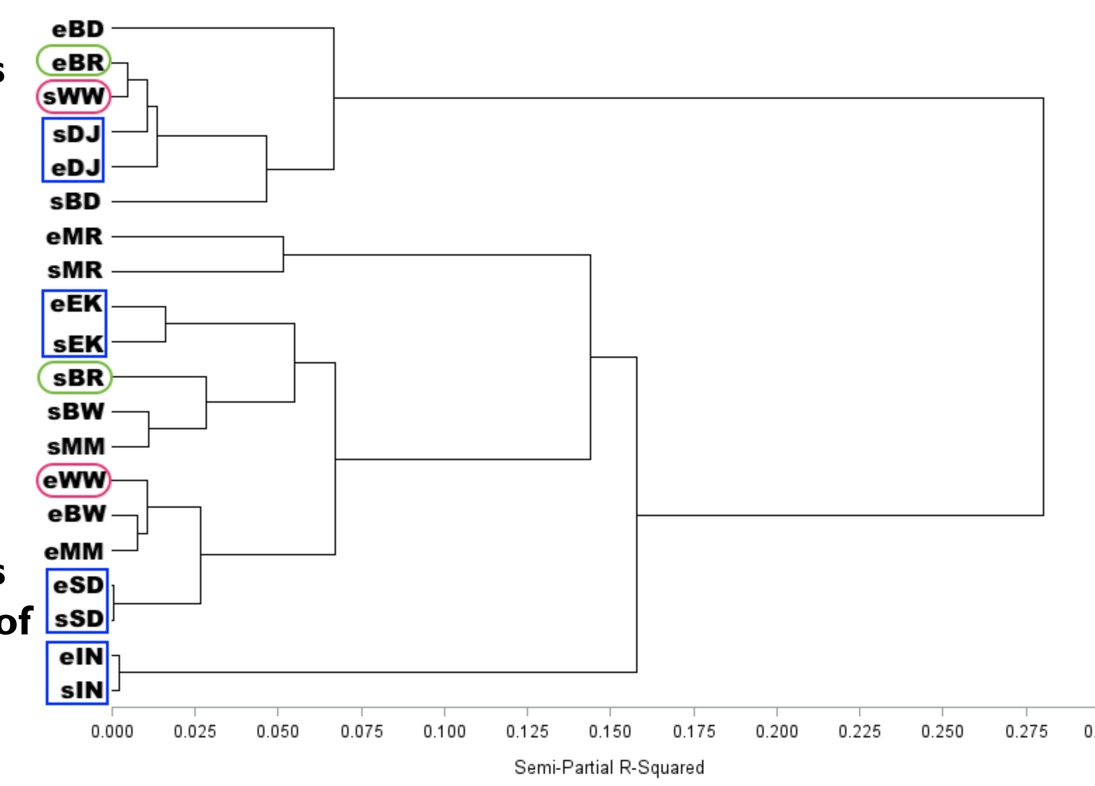
CE was made by kneading 100g dry equivalent mass compost in a 450um nylon mesh bag submerged in 1000mL total water.

Left: Color and turbidity differences of extracts are evident after settling.

Bacteria & Fungi, Protozoa & Nematodes

Fatty Acid Methyl Ester (FAME) extractions profile the membrane and storage lipids of microbial communities. Some FAMEs are indicators of specific microbial groups including saprophytic fungi. Microscopic count methods are used by practitioners of the "soil food web" management approach to quantify and qualify microbial groups.

Cluster analysis of 15 unique FAMEs from each solid compost (s-) compost and extract (e-) shows that community structure of CE does not always represent that of its compost.



ID	Bacterial FAMEs (nmol/mL)	Microscope Bacteria (ug/mL)	Fungal FAME (nmol/mL)	Microscope Fungi (ug/mL)	Nematode (#/100mL)	Feeding group %B/%F/%P *	Microscope Flagellate protozoa** (#/mL)	Microscope Amoebae** (#/mL)
BD	37.3	-	2.8	-	711.6	100/0/0	-	-
MS	7.5	2937.0	2.1	55.5	1.4	100/0/0	5,715	0
BR	6.3	839.1	1.0	17.5	15.5	90/10/0	0	0
EK	6.0	400.3	0.7	0.0	0.0	-	0	0
DJ	4.8	376.2	0.6	272.4	1.4	0/100/0	4,018	16,073
WW	3.7	622.4	0.3	78.5	1.4	100/0/0	0	0
SD	7.0	2331.4	0.9	80.4	4.2	67/33/0	0	0
IN	22.7	-	1.8	-	0.0	-	-	-
BW	12.1	3508.3	2.2	750.7	54.8	10/89/1	31,778	74,148
MM	4.4	-	0.7	-	0.0	-	-	-

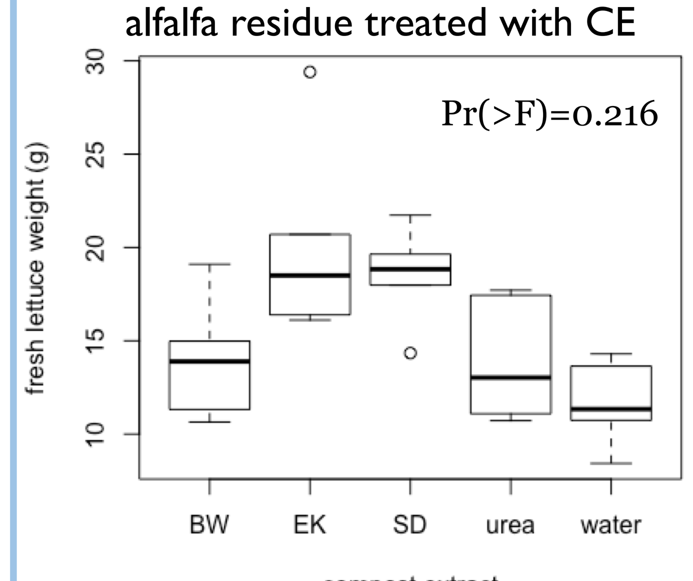
*B – Bacterial feeders, F – Fungal feeders, P – Predators.
Nematodes measured by sugar centrifugation/extraction
** Only active protozoa counted
Bacterial FAMEs vs Microscope Bacteria $R^2 = 0.722$
Fungal FAMEs vs Microscope Fungi $R^2 = 0.277$

-Three testate and one flagellate amoebae from BW pictured above and at lower left.
-*Pelodera sp.* 400x above from BW
-*Diploscapter sp.* 1000x present in BW and BD below, left (anterior)
-*Boleodorus sp.* 1000x from BW below, right (anterior)

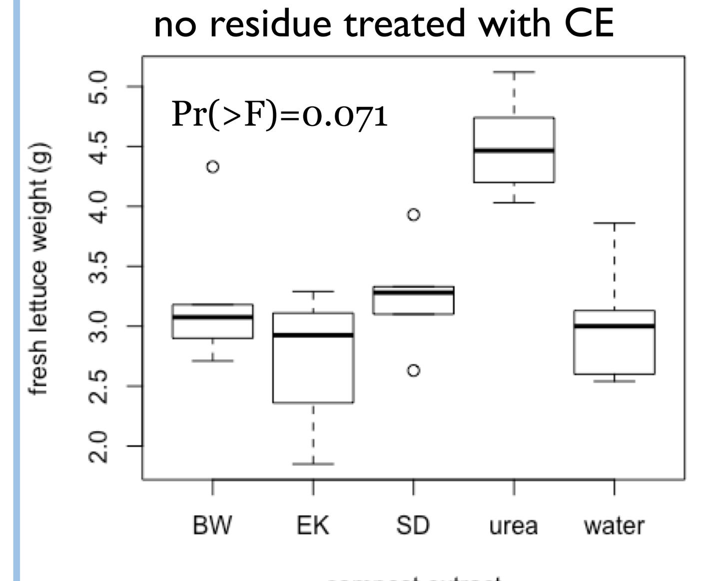
Lettuce growth in soil with CE inoculated residues

In a greenhouse experiment, CE treatments (EK,SD,BW,urea N control ,none) were applied to residues (alfalfa [5 ton/ac], oat straw [2ton/ac], polylactic acid mulch loaded with wood particles (PLA) [1.7 ton/ac], geotextile, none) at 3lb N/ac, which were incorporated into a steam pasteurized sand/soil /peat/vermiculite blend in 4" square pots. Lettuce was sown two weeks after incorporation and fresh above-ground weight was measured 42 days after planting. r=6

Lettuce growth response in soil with alfalfa residue treated with CE



Lettuce growth response in soil with no residue treated with CE



Mean fresh weight of lettuce in pots treated with no residue, PLA, and geotextile increased in response to 3 lb N/ac from urea. Trends within PLA and geotextile are comparable to those found in the boxplot at left. Straw residue prevented any seedlings from progressing past the first true leaf stage, and no differences due to CE were found. However, in the alfalfa treatment, fresh lettuce weight did not respond to urea, while EK and SD tended to increase fresh weight. BW, despite representing the greatest import of all microbial groups, did not result in increased fresh weight of lettuce.

Discussion

CE varies widely in microbial composition, further, the community structure of solid compost may be altered when CE is prepared. Current progress in this project suggests that residue inoculation with CE has no short term effect on plant growth in nutrient limited soils or soils with fresh high carbon residue. Weak evidence suggests that CE may accelerate processing of high nitrogen residues, however neither presence of microfauna nor elevated bacterial of fungal indices from either measure (FAME or microscopy) seems to predict this.

USDA

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