Microbial Biomass and Nitrogen Cycling as Affected by *A. trapezoides* in a Colorado Soil

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Introduction

- Colorado earthworms are nonnative lumbricid species
  - Not widely distributed across the state
  - *Aporrectodea trapezoids* appear to be the most common species in irrigated soils.
- Growing interest in use of earthworms in dryland agroecosystems to promote:
  - Residue incorporation
  - Alter soil structure and porosity
  - Improve water infiltration
  - Enhance microbial activity through nutrient cycling
- There are three general groups of earthworms
  - Endogeic earthworms (soil feeding)
  - Anecic earthworms (soil and litter feeding)
  - Epigeic earthworms (litter feeding)

Objectives

The objectives of this study were to answer the following questions:

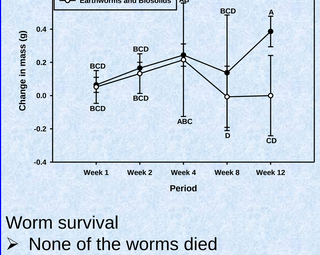
- Can endogeic earthworms survive in a low-organic matter, cultivated soil from eastern Colorado (Adena, Ustic Paleargid)?
- Can earthworm survival be enhanced with biosolids additions?
- Do earthworms affect microbial biomass and N cycling activities?

Methods and Materials

- Earthworm Sampling
  - Collected adult earthworms by hand sorting
- Lab Incubation Study:
  - 4 treatments were set up (4 replications)
    - Control soil
    - Control with worms
    - Control with biosolids
    - Control with worms and biosolids
  - Biosolids incorporated into 1 Kg of soil at a rate equivalent to 11.2 Mg dry biosolids / ha
  - Destructively sampled after 1 wk, 2 wk, 4 wk, 8 wk, and 12 wk
  - Moisture was maintained at 70% of field capacity (14.7 %)
  - Temperature maintained at 17º C
- Statistical Analyzes:
  - Proc GLM in SAS 9.2
  - Alpha=0.1

Results

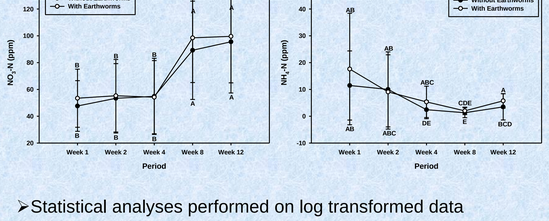
Change in Worm Mass



Worm survival

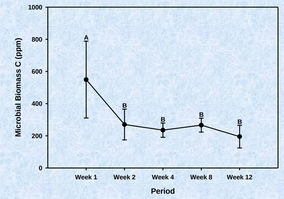
- None of the worms died
- Biosolids did effect the worm mass at 12 weeks compared to the control

Effects on NO_3-N and NH_4-N



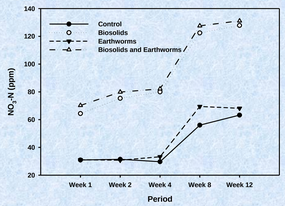
- Statistical analyses performed on log transformed data
- Earthworms increased NO_3-N availability (P = 0.0616)
- Biosolids by week interaction on NO_3-N (P = 0.0054)
- Earthworms increased NH_4-N availability (P = 0.0021)
- Biosolids by week interaction on NH_4-N (P = <0.0001)

Microbial Biomass C

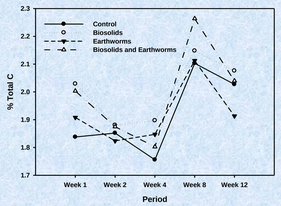


- Statistical analyzes was preformed on log transformed data.
- The earthworms did not have a significant effect on microbial C (P = 0.7380)
- Biosolids were only slightly significant (P = 0.0811)
- Week effect was significant (P = 0.0031)

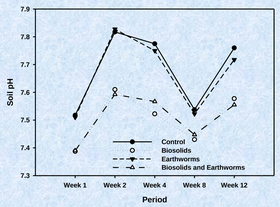
Evidence of Nitrification Taking Place from Week 4 to Week 8



- Increase in soil NO_3-N from week 4 to week 8
- Took place across all treatments

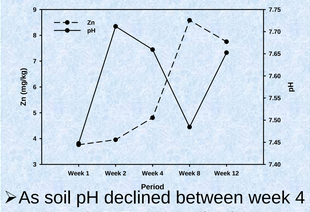


- Increase in total percent C from week 4 to week 8
- There were not any amendments added after time 0



- Decrease in soil pH from week 4 to week 8
- Took place across all treatments

Zn and pH Relationship



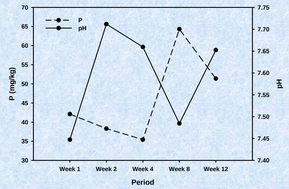
- As soil pH declined between week 4 and week 8, Zn bioavailability increased

Week 4 to Week 8 Changes

Treatment	Moles of C added per Kg of soil
Control	0.28
Earthworms	0.22
Biosolids	0.21
Biosolids and Earthworms	0.39

- Autotrophic nitrification added C to the soil
- There is a trend for a synergistic effect of biosolids and earthworms on C fixation but is not statistically significant
- Nitrification results in a reduction of the soil pH
- Change in availability of nutrients and metals due to pH changes

P and pH Relationship



- As soil pH declined between week 4 and week 8, P bioavailability increased

Earthworms collected from field sampling

Cast from earthworms on soil surface after 2 weeks

Earthworm burrow with earthworm

Conclusions

- *A. trapezoides* can survive in moist soil from eastern Colorado
- Biosolids do not negatively impact *A. trapezoides*
- *A. trapezoides* increased availability of inorganic N
- Microbial nitrification activity affected soil C, pH and nutrient availability between week 4 and week 8

Future Plans

- Conduct a laboratory study on earthworm survival with varying water contents
  - Hope to determine the ability of *A. trapezoides* to survive the moisture conditions of eastern Colorado
- Conduct an additional laboratory study on *A. trapezoides'* effect on nitrate leaching potential
  - Study both unsaturated and saturated flow

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