

Forestry, Wildlife and Fisheries Graduate Seminar

“Trees Adaptation to Mercury Contaminated Soils along East Fork Poplar Creek, Anderson and Roane Counties, Tennessee”



Presented by: Sharon Jean- Philippe
Monday, October 19, 2007
4:40 p.m.
160 PBB

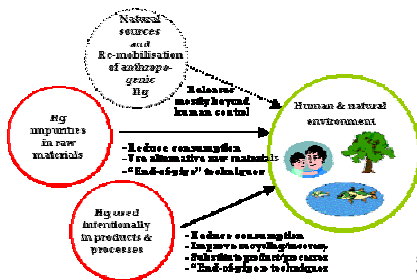


Outline

- Project Relevance
- Background
- Methods
- Future project directions

Project Relevance

- All soils have been exposed to mercury through atmospheric deposition.



Side provide by:
www.greenfact.org

Project Relevance

- Adaptation of trees surviving in contaminated soil with heavy metals is mainly due to **phenotypic plasticity** and/or **microbial community** connections.

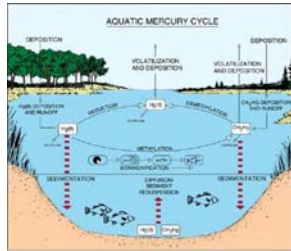


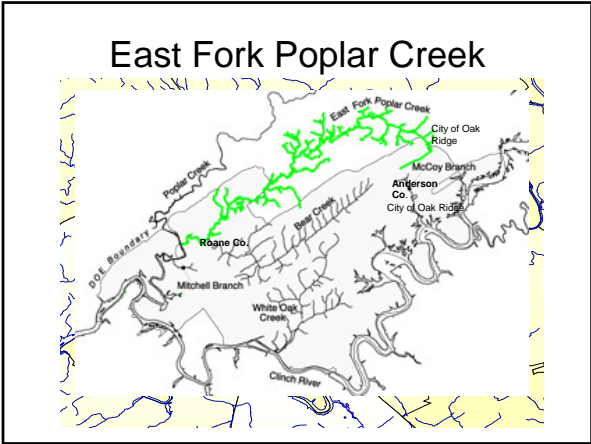
Image provided by - syfel.wordpress.com

Project Relevance

- Understanding these **mutualistic** associations between **tree roots** and **fungi** in contaminated areas is valuable because trees processing extensive root systems in association with fungi along streamside may be important in **immobilizing mercury** in the environment.

Background

- Y-12 National Security Facility during 1950s and 1960s was used to manufacture nuclear weapons.
- Estimated levels of total mercury in the floodplains soils along the creek in 1984 ranged from 0.5 to 3000 ppm.
- In the early 1990's Science Applications International Corporation (SAIC) found total mercury levels ranging from 0 ppm to >200 ppm.



Research Questions

- How do trees adapt to mercury contaminated soils along EFPC?
- What is the primary symbiotic association?
- Where is the mercury localized within the tree's compartments?

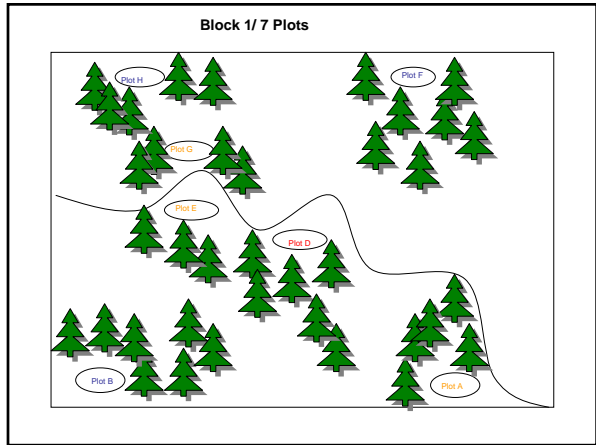
Hypothesis 1

Mycorrhizal roots are more prevalent in high plots versus the low or medium plot along East Fork Poplar Creek.

Methodology

- Establish vegetation plots
- Soil sampling
- Verification of mercury using IR spectroscopy

Establishment of Vegetation Plots		
Block 1	Block 2	Block 3
Plot A – low medium	Plot A – high	Plot A – low
Plot B – low	Plot B – medium	Plot B – low
Plot B – high	Plot C – low	Plot C – low
Plot E – medium		Plot D – medium
Plot E – low	→ 50 – 200 ppm	Plot E – high
Plot G – medium		Plot F – medium
Plot B – high	→ > 200 ppm	Plot G – medium





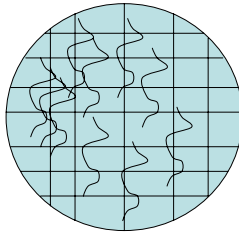
Soil Sampling

- During the months of June - 2007 and October - 2007 and June - 2008 and October - 2008 soil samples will be collected along EFPC. Three soil cores per plot totaling 21 cores ranging from 6 – 12 inches.



Soil Sampling: Gridline Intersection Method

- Characterize the mycorrhizal roots as endo- or ectomycorrhizal.
- Fungal roots are washed, cleared and stained and mycorrhizal colonization was assessed under a dissecting microscope.



Soil Sampling

- Physio-chemical components of the soil will be determined.
 - pH, water content, macro- and micronutrients (Ca, N, P, Bo...)
- Verify the three contamination levels low (0 -50 ppm), medium (50 – 200 ppm) and high (<200 ppm) obtain from the creek.

Hypotheses 2 & 3

Tree seedlings with mycorrhizal roots are more tolerant to mercury than tree seedlings that are non-mycorrhizal.

The location of mercury is mainly within the below ground components of the tree seedlings.

Methodology

- Growth Chamber Study
- Evaluate seedlings function
- Analyze roots, stems and leaves using IR spectroscopy

Preliminary Growth Chamber Study

- Ninety-six 1-year old American sycamore seedlings were planted in 2:1 vermiculite/sand media.
- Inoculate with soil cores obtained from mercury contaminated sites along the creek allowed to establish for 6 months.
- Control no soil cores





Preliminary Growth Chamber Study

- Ninety-six 1-year old American sycamore seedling were planted in 2:1 vermiculite/sand media allowed to establish for 6 months.
- Inoculate with soil cores obtained form mercury contaminated sites along the creek.
- Water seedlings with 5 ppm (0.005 mg/kg) mixture of mercury compounds (HgNO_3 , CH_3HgCl , HgSO_4).

Evaluation of seedlings response to mercury application

- Leaf transpiration
 - Root respiration
- IRGA or Portable Photosynthesis System
- Examine the presence of fungal colonization.
 - Analyze roots, stems and leaves using infrared spectroscopy.

Infrared Spectroscopy

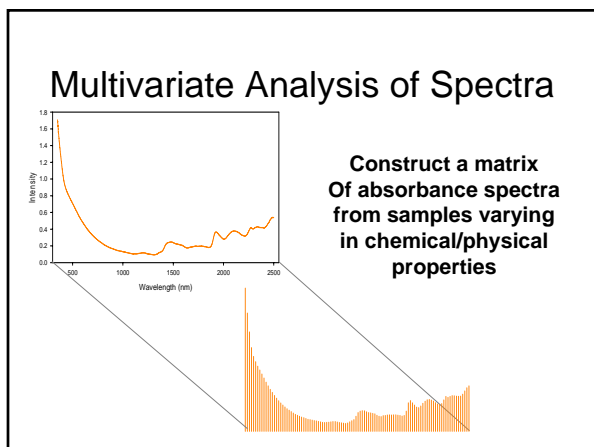
- Verify the three contaminated levels along EFPC.
- Analyze roots, stems and leaves using infrared technology.

Infrared Spectroscopy

- Two ranges will be used to identify mercury:
 - Near Infrared
700 – 2500 nm
14285 – 4000 cm^{-1}
 - Mid-infrared
2500 - 16000 nm
4000 – 600 cm^{-1}







- ### Future Project Direction...
- Analyze soil cores collected:
 - Chemical components
 - pH, water, macro- and micronutrient
 - Mercury compounds
 - Infrared spectroscopy
 - Mycorrhizal association
 - Process roots
 - Initiate growth chamber study
 - Write.....

Growth Chamber Study

- Plant sterile seeds/sterile media
- Inoculate with soil cores obtained from mercury contaminated sites along the creek allow to establish for 6 month.
- Water seedlings with 5 ppm (0.005 mg/kg) mixture of mercury compounds.

Thank you

Major Professor - Jennifer Franklin

Committee members- Nikki Labbé, Karen Hughes, & David Buckley

Field Crew: Stuart Wilson, Douglas Godbee, Jerry Middleton, Stephane Jeckel

Technical Crew: Nikki Labbé, Nicolas André

Forestry, Wildlife, & Fisheries Department

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Any Questions?
