Comparative Genomics of Soil-persistant *E. coli*

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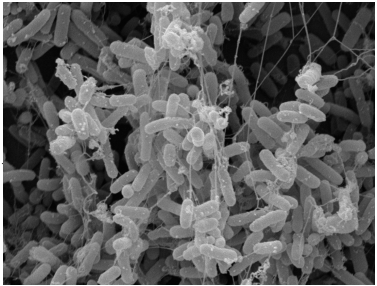
Introduction

- Overview of soil-persistent *E. coli*
- Research questions
- Experimental design
- Results
- Next Steps

E. coli: commensal or pathogen?

- Gram negative
- Beneficially occurs in the gut
- Can infect gi and urinary tracts
- Health burden: ~5 million DALY
- Used as contaminaiton indicator



[1]Image source: NDSU

A Brief History of Soil-persistent E. coli

- **1886** · Escherich: Discovery of *E. coli*
- **1948** · Bardsley: Soil may act as reservoir for *E. coli*
- **1963** · W. and J. Boyd: Cold persistence observed
- **1972** · Evans, et al: Drainage related to coliform counts
- **1988** · Fujioka and Shizumura: Alternative indicators suggested
- **1997** · Texier, et al: Stable populations exist in alpine grasslands
- **2003** · Byappanahalli, et al: Soil persistence is widespread
- **2010** · Brennan, et al: Persistence in maritime temperate soils

Research Questions

Genomic Context

- Are soil-persistent *E. coli* related?
- Do soil-persistent *E. coli* possess certain traits?

Virulence

- Are soil-persistent strains pathogenic?

Experimental Design: Background

Ryan and Fanning: Effects of N and slurry on soils

- Isolate and protect grassland soil columns
- Apply treatment, test leachate
- Last application of slurry in 1998

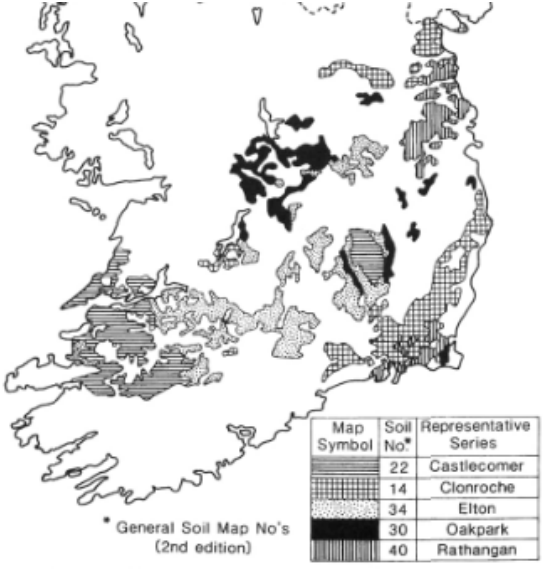
Brennan, et al: Pathogen survival and transport in soils

- Two conditions: Cattle slurry and control
- Compare coliform counts in leachate

Experimental Design: Current

- Collect leachate from control lysimeters
- Enrich for *E. coli*
- Purify, sequence genomes
- Compare genomics of soil strains to wider *E. coli* pangenome

Soil Samples



Lysimeters

Lysimeters

Lysimeters

Lysimeters

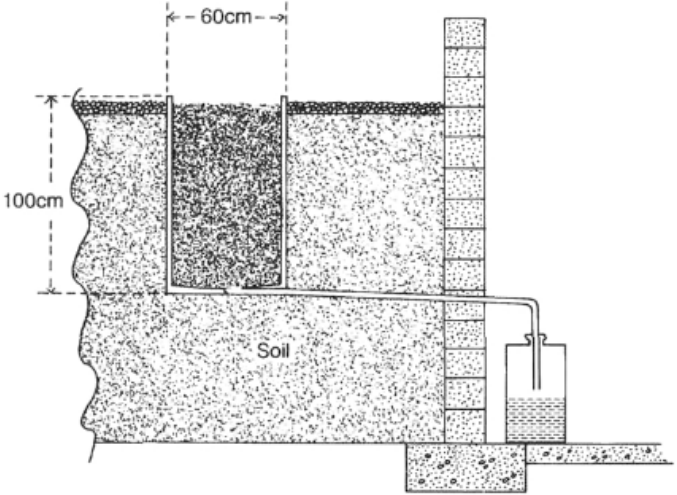
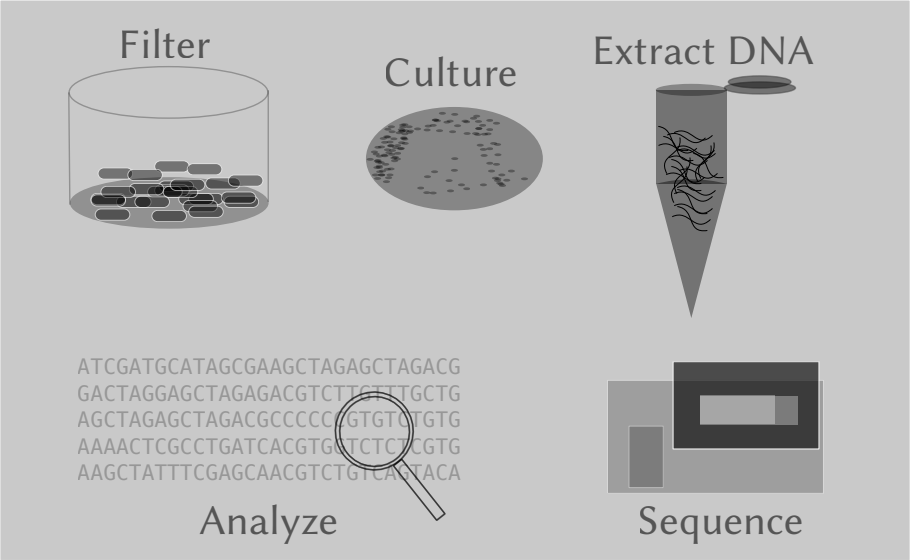


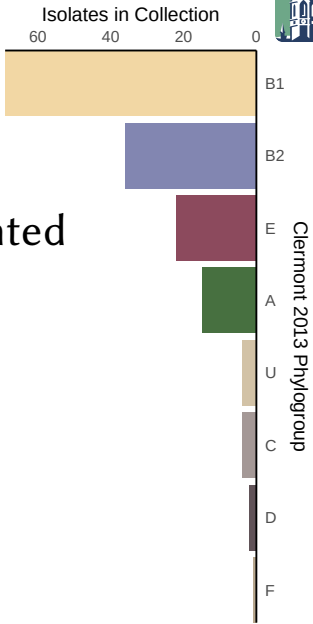
Figure 1: Representation of soil monolith in the lysimeter unit.

Workflow

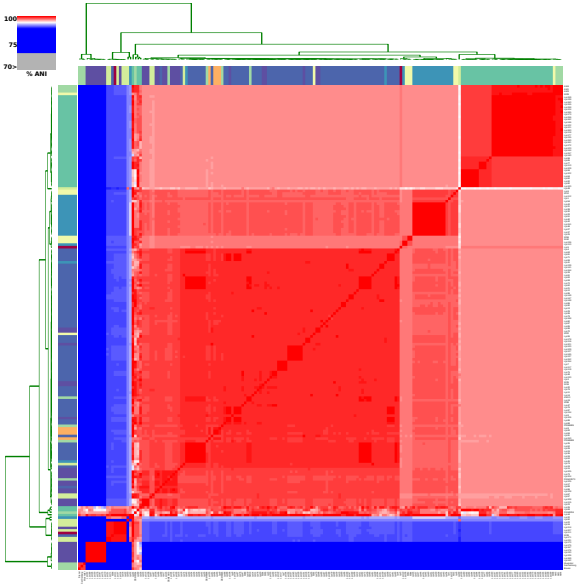

Filter
Culture
Extract DNA
ATCGATGCATAGCGAAGCTAGAGCTAGACG
GACTAGGAGCTAGAGACGTCTTCTTTGCTG
AGCTAGAGCTAGACGCCCCCCGTGTCTGTG
AAAACTCGCCTGATCACGTGCTCTCTCGTG
AAGCTATTTCGAGCAACGTCTGTCAGTACA
Analyze
Sequence

Genomic Context

- 202 isolates sequenced
- 153 true *E. coli* passed QC
- All Clermont phylotypes represented
- Diverse phenotypes
  - curli
  - metabolism
  - biofilm



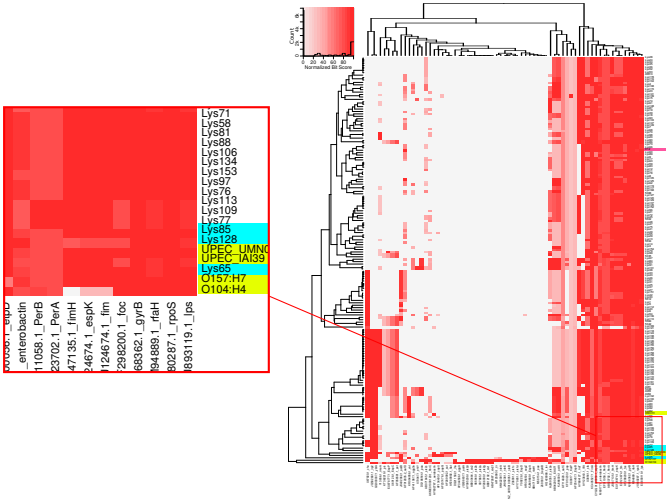
Genomic Context



Virulence

- Search literature for genes implicated in virulence
- Select representative sequences for ~50 virulence factors
- Use reciprocal translated blast to find occurrences
- Filter results, visualize

Virulence Results



Conclusions about Soil-persistent *E. coli*

- Represent diverse lineages
- Posess virulence genes, but no *stx* toxins
- May pose a human health threat
- Complicate use of *E. coli* as contamination indicator

Next Steps

- Determine whether virulence genes are functional
- Explore genomes for markers associated with soil isolates
- Explore trends potentially relating function to environmental factors

Sources

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Questions?