Are Pathogens A Concern In Reclaimed Wastewater Used For Municipal Irrigation?

Jean McLain

Research Soil Microbiologist
US Arid-Land Agricultural Research Center, Maricopa, AZ

Outline

The microbiology of reclaimed water

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Methods that we use in our lab

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The microbiology of reclaimed water

Methods that we use in our lab

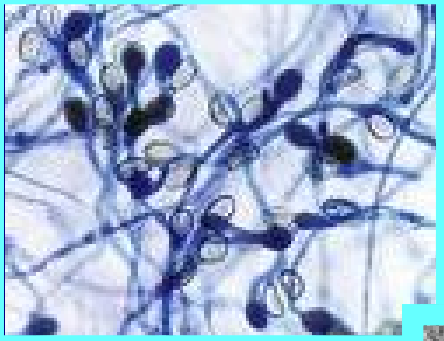
Field study: *E. coli*

Field study: *Salmonella*

Microbiology of Reclaimed Water

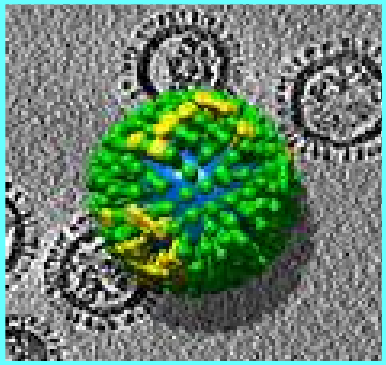
Recycled water leaves the treatment plant cleaned to within regulatory guidelines, but irrigation water may contain viable microorganisms

Bacteria



Fungi

Viruses

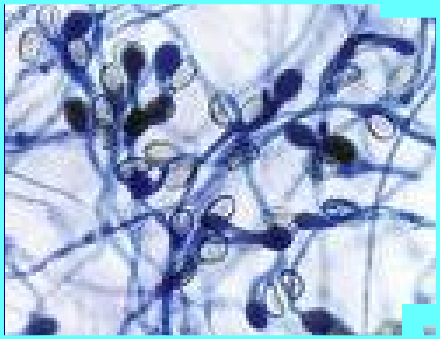


Microbiology of Reclaimed Water

Some of these microorganisms, if inhaled, can cause serious disease in humans

Pathogen survival could lead to off-target environmental quality problems

Bacteria



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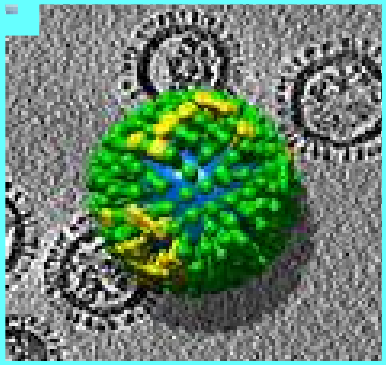
Viruses

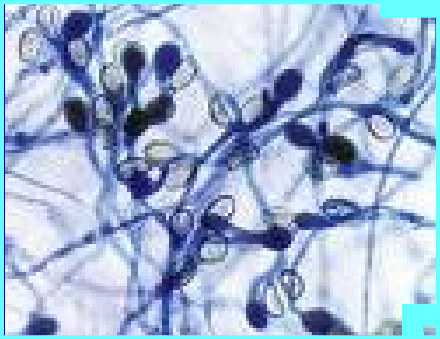


Microbiology of Reclaimed Water

Irrigation water quality: not possible to test for every single disease-causing organism

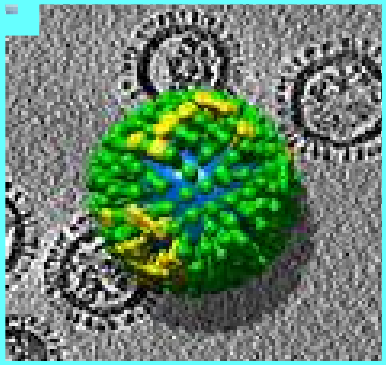
We rely on tests for "indicator organisms" such as *E. coli*

Bacteria



Fungi

Viruses



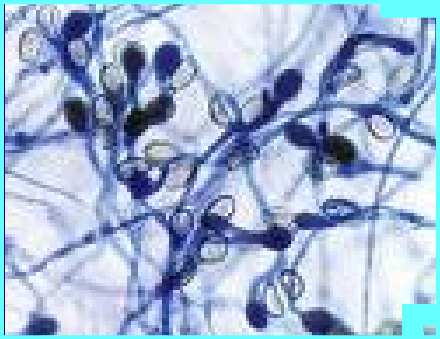
Microbiology of Reclaimed Water

Irrigation water quality: not possible to test for every single disease-causing organism

We rely on tests for "indicator organisms" such as *E. coli*

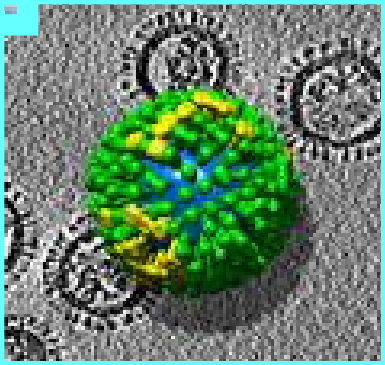
Presence of *E. coli*: Indicates fecal contamination

Bacteria



Fungi

Viruses



McLain Lab: Assessing the Environmental Safety Of Reclaimed Water

Bacterial re-growth in water transmission systems

Pathogen survival or proliferation in the environment

Pathogen movement from point of application

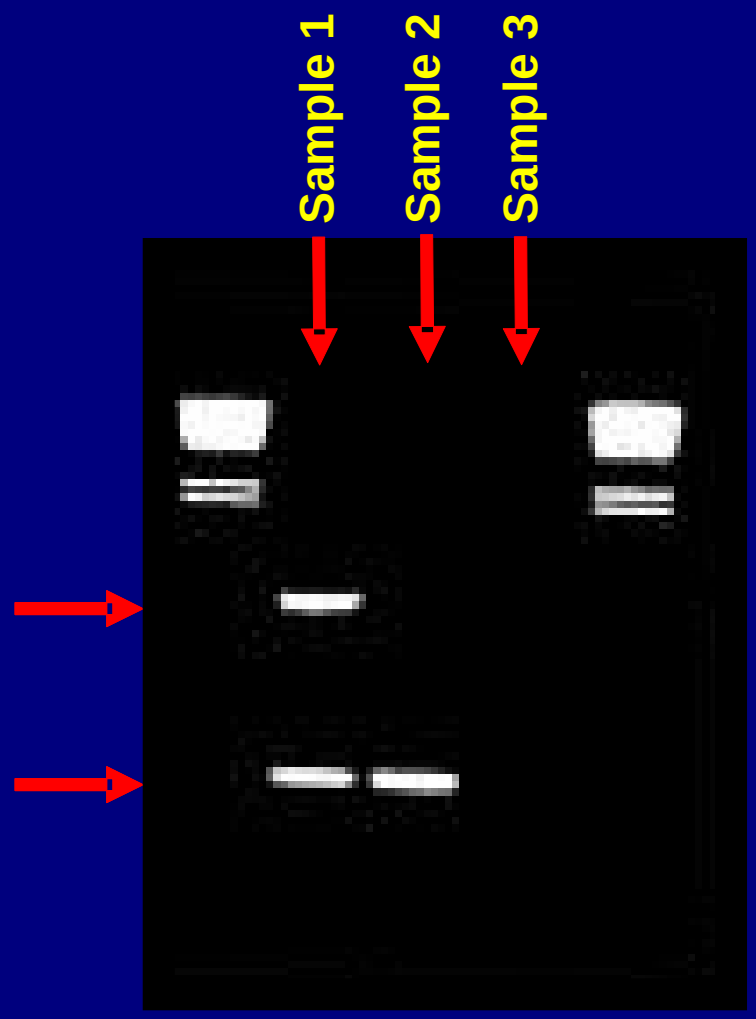
Tools: Serial Dilution Plating Methods

Tools: Analysis of Bacterial DNA Extracted from Soil and Water Samples

PCR

Bacteria have genes within their DNA that can identify a particular species, or strain

PCR is an enzymatic reaction that can be used amplify a specific target gene



Pathogenic *E. coli* in Tres Rios Constructed Wetland

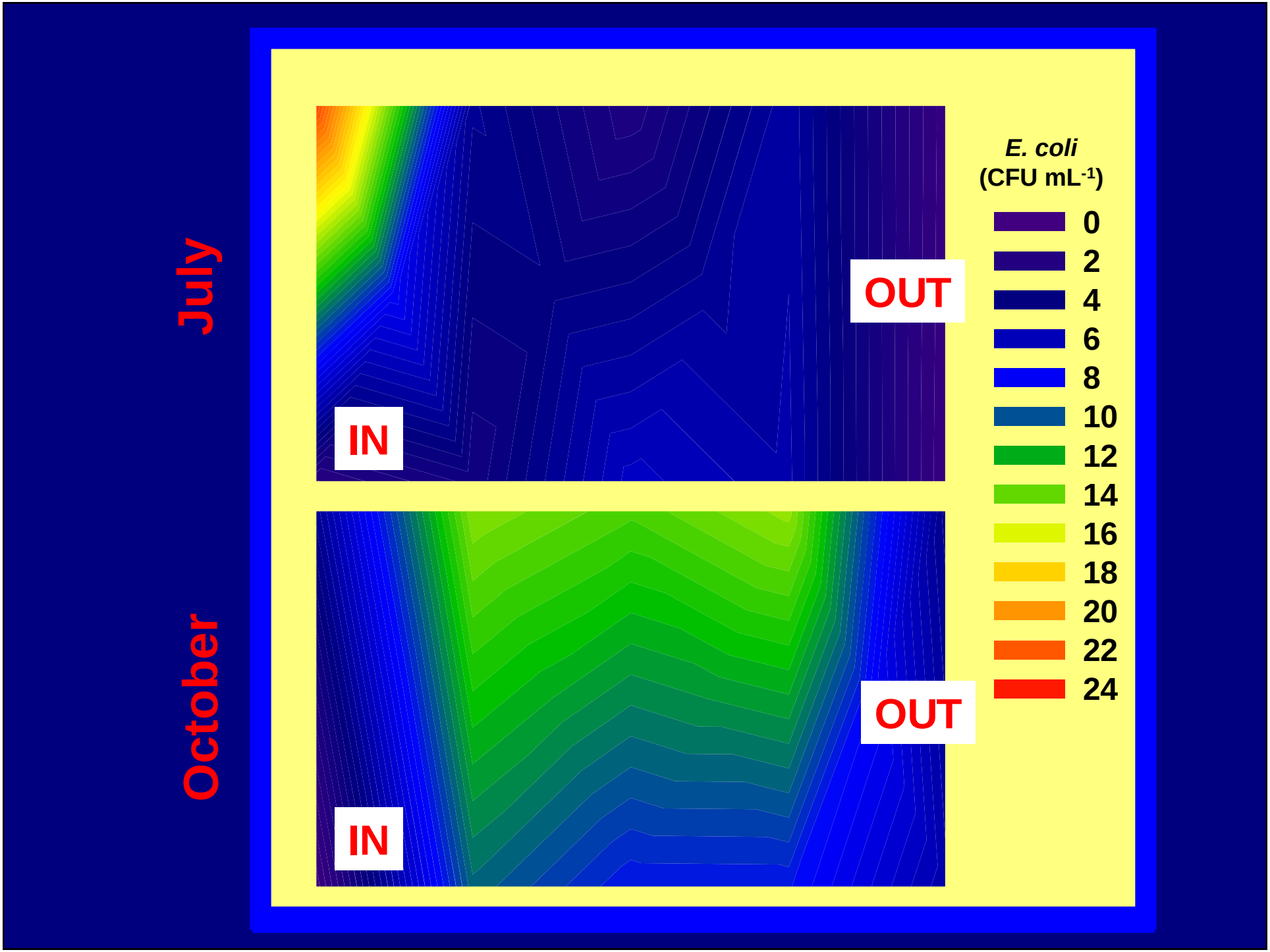
91st Avenue WWT Facility

Water entering wetland: no viable enteric bacteria

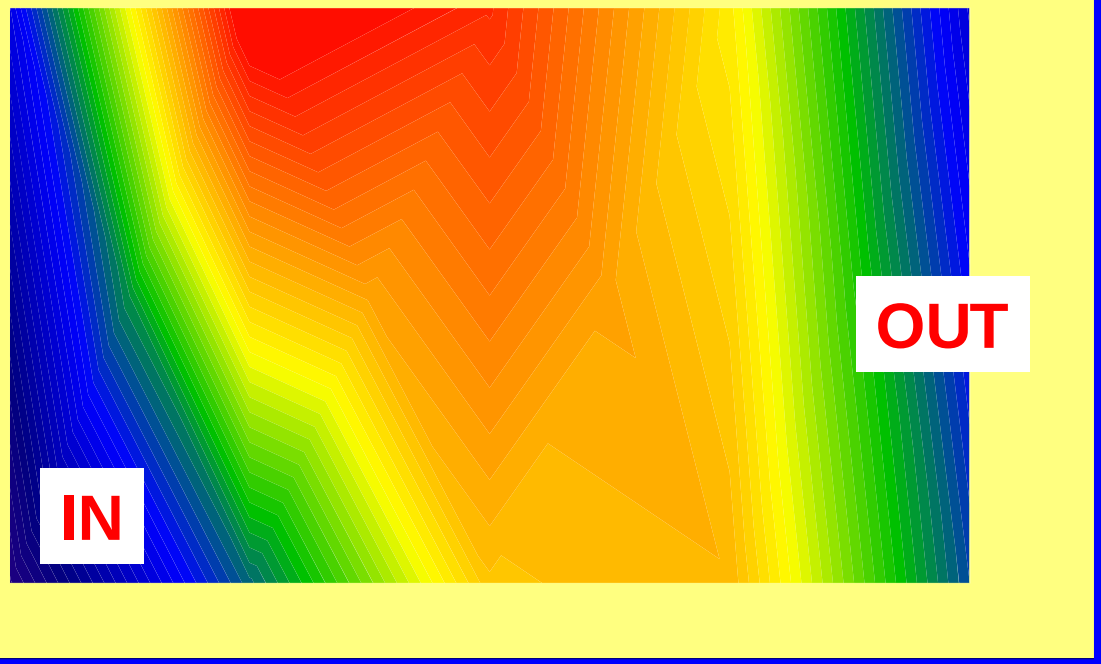
Seasonal *E. coli* blooms as high as 20,000 CFU per 100 mL

AZ guidelines for urban irrigation: 800 CFU per 100 mL

Pathogen movement to surrounding waterways? Harm to public?


July
October
IN
OUT
IN
OUT
E. coli
(CFU mL-1)
0
2
4
6
8
10
12
14
16
18
20
22
24

December



E. Coli
(CFU mL^{-1})

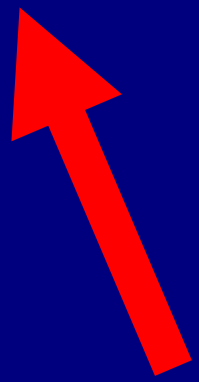
0
2
4
6
8
10
12
14
16
18
20
22
24

Summer measurements: waters within AZ-DEQ guidelines for urban irrigation

By October, *E. coli* levels in waters leaving the wetland were far above guidelines

A Pathogen Threat to the Environment?

Indicator bacterium ≠ Pathogenic bacterium



Only indicates fecal contamination, does not indicate presence of pathogenicity

A Threat To the Environment?
E. coli Pathogenicity Testing

Three thousand known strains of *E. coli*, relatively few are pathogenic to humans

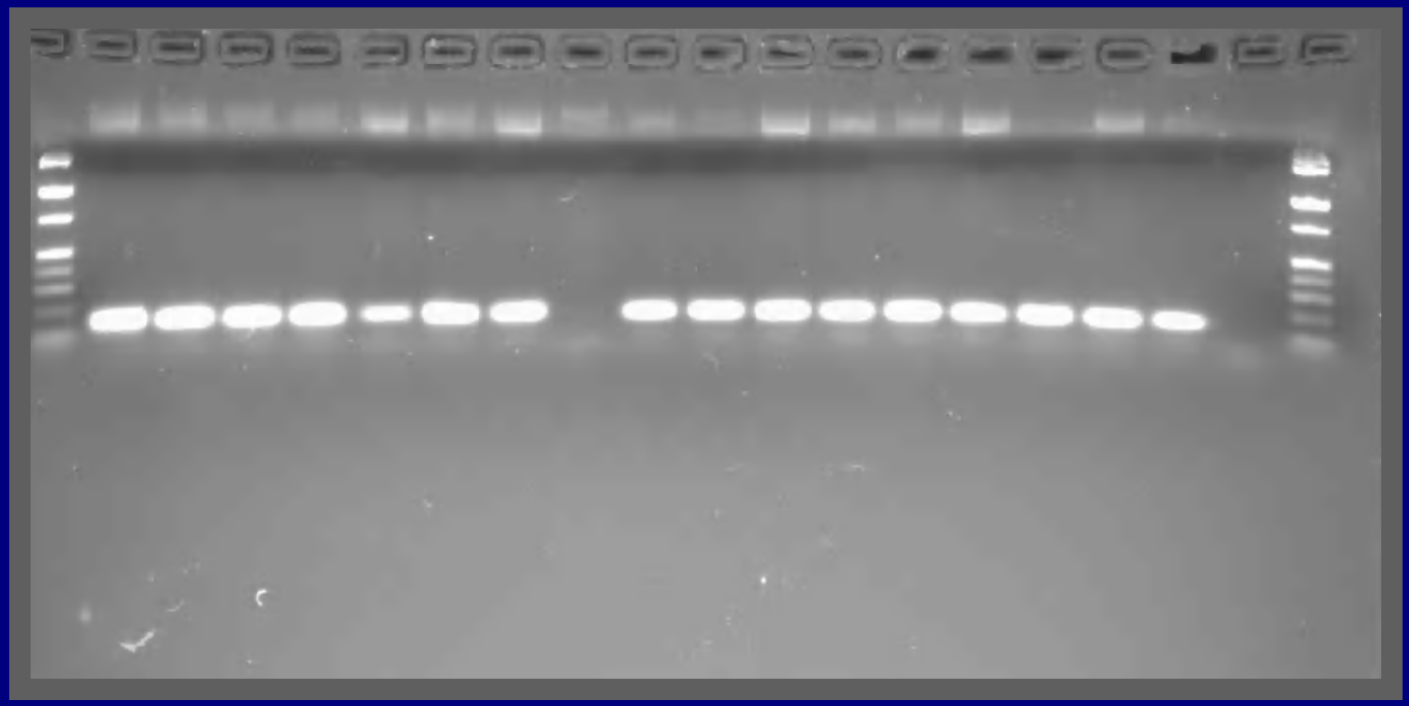
Non-pathogenic *E. coli* leaving the wetland are not an environmental health concern

Pathogenic *E. coli* are subdivided into virotypes depending on the pathway that they use to initiate disease

O157:H7 is a verocytotoxigenic *E. coli*

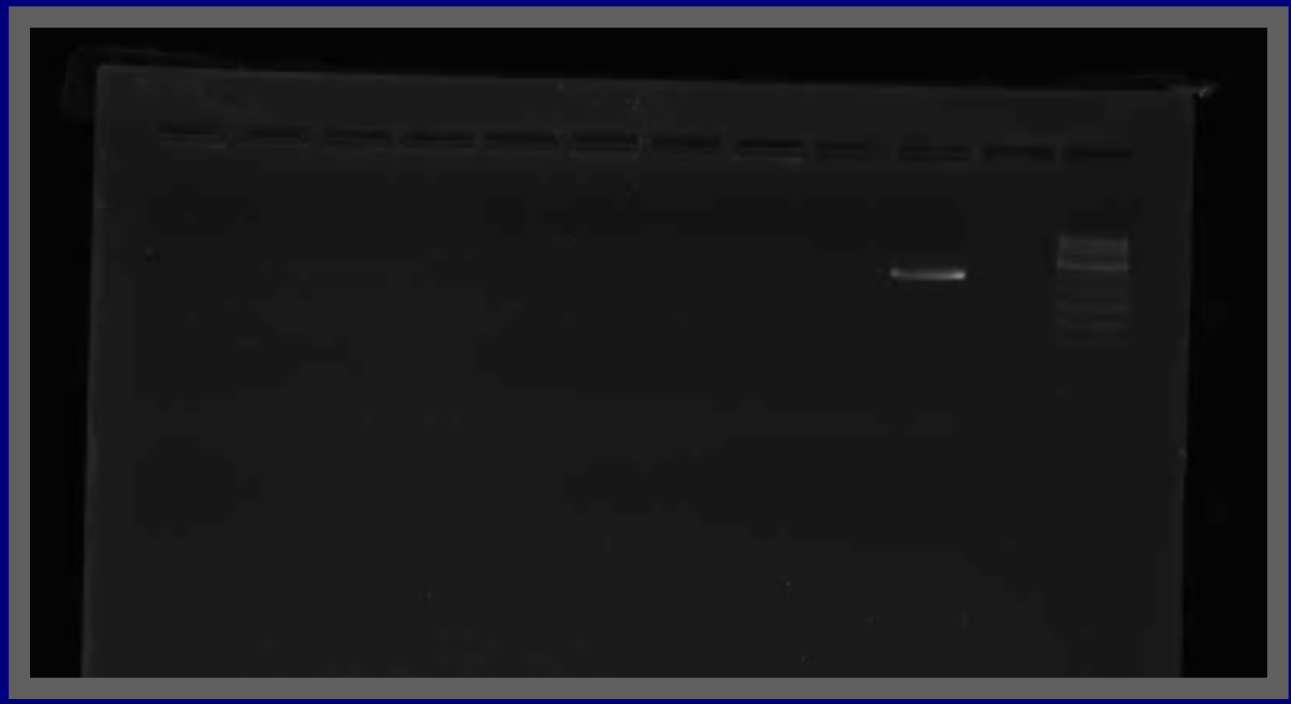
Seven PCR reactions to test for presence of genes responsible for disease initiation

Pathogenicity Testing: PCR Results



Positive control strains: strong presence of virulence genes identified by PCR

Pathogenicity Testing: PCR Results



Wetland *E. coli* strains: NO virulence genes identified to date

Why Is This Work Important?

Plating methods told us that this water was unsafe, but molecular testing revealed no pathogens. This illustrates the need for strict testing for accurate representation of microbiological results

Will aid in improved identification of disease-causing bacteria in fresh water systems: possible development of “improved indicators”

Pathogen Survival In The Environment: Pacana Park, City of Maricopa

Most enteric pathogens survive best in "human body" conditions

Survival in the environment (??)

Measurements

Presence of viable pathogens (*E. coli*, *Salmonella*)

Survival and transport of indicator bacteria

Pathogen survival and transport

Salmonella

Approximately 1300 known strains of *Salmonella*

All strains are capable of causing disease in warm-blooded animals

Key question: infective dose?

Pacana Park: Early Results

Salmonella **found in pond, irrigation water, and in 0-5 cm soil layer**

No detectable *Salmonella* in 5-10 cm soil layer

Salmonella **is present in irrigation water, but no detectable survival or movement**

Why Is This Work Important?

At present, public concerns about the perceived risks weigh heavily against the use of reclaimed water for municipal irrigation

Detailed scientific study on effluent use is needed to aid in making informed decisions concerning future uses of recycled water

As a Turfgrass Professional, Knowledge of the Microbiological Qualities of Your Applied Irrigation Water is Very Important

Teen Girl Remains In Hospital After E. coli Infection From Restaurant

FOX NEWS.com

CNN.com

***E. coli* found in MS water supply**

FDA issues alert after salmonella found in locally-made dog chew

msnbc

The New York Times

Lake Forest Restaurant Linked To 3 More E. Coli Cases

Acknowledgements