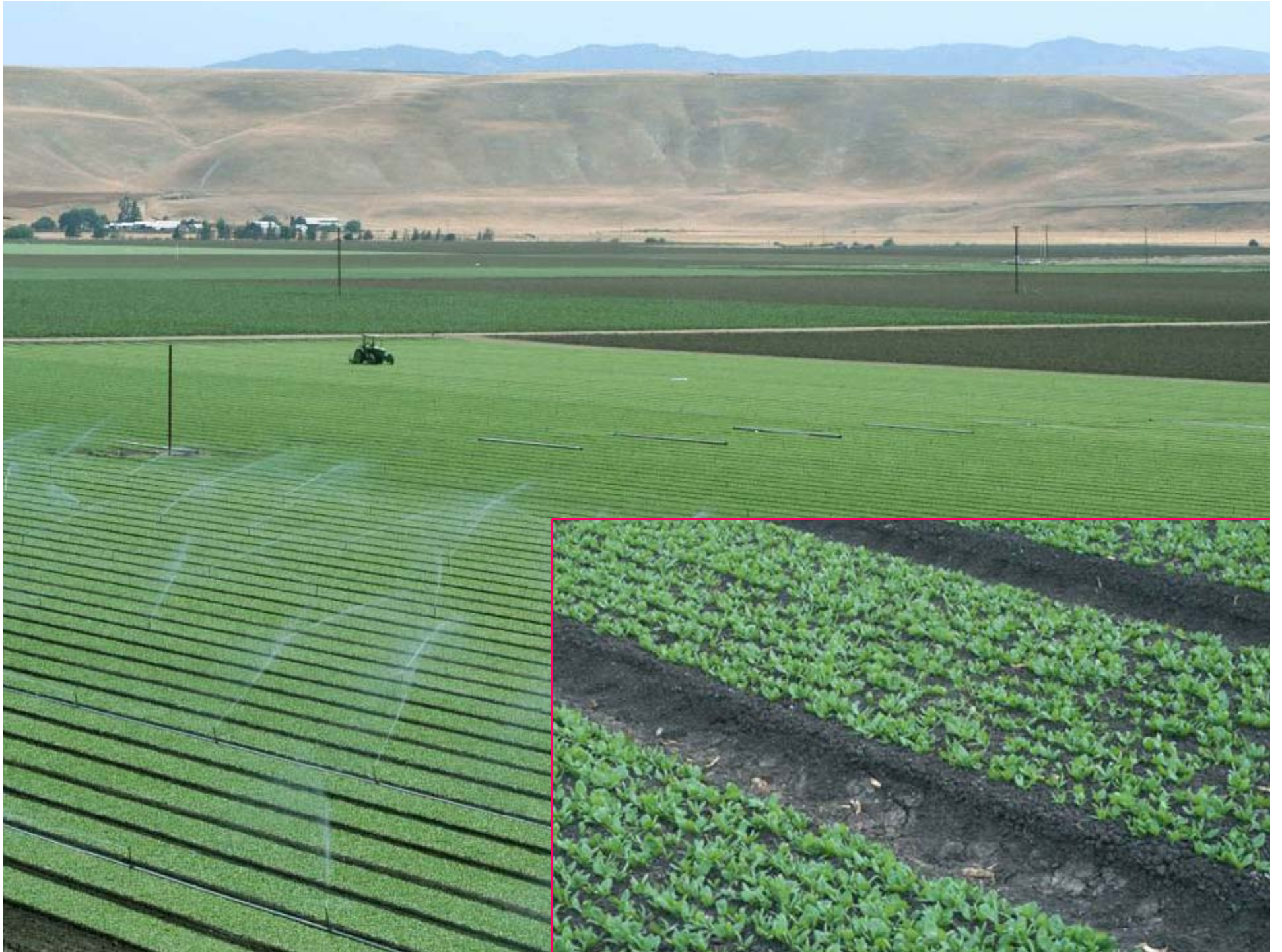
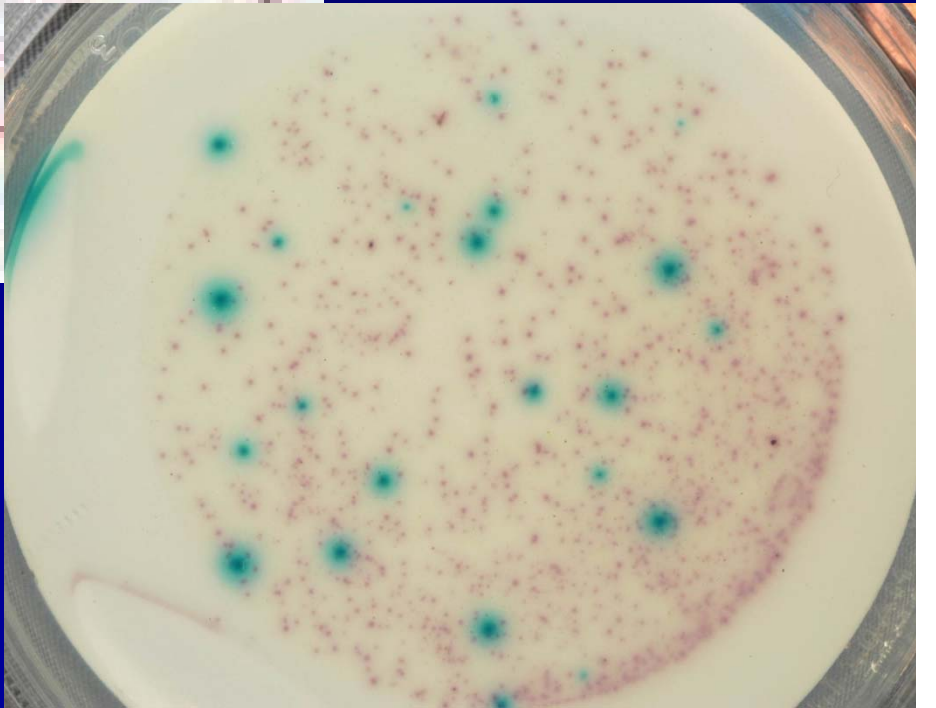


Water, Irrigation, and Impacts on E. coli

**Steven Koike, Mike Cahn,
and Trevor Suslow
University of California**





UC Cooperative Extension: Long-Term Objectives

- **Conduct practical field studies that contribute to an understanding of how E. coli and other foodborne pathogens exist and survive in agriculture.**
- **Provide guidance for minimizing risks from foodborne pathogens and for improving metrics and regulatory guidelines.**

2007 Field Experiments

- **Examine soil survival of generic E. coli under field conditions.**
- **Evaluate irrigation methods and soil nutrient levels on generic E. coli survival.**
- **Develop and refine detection methods for E. coli research.**

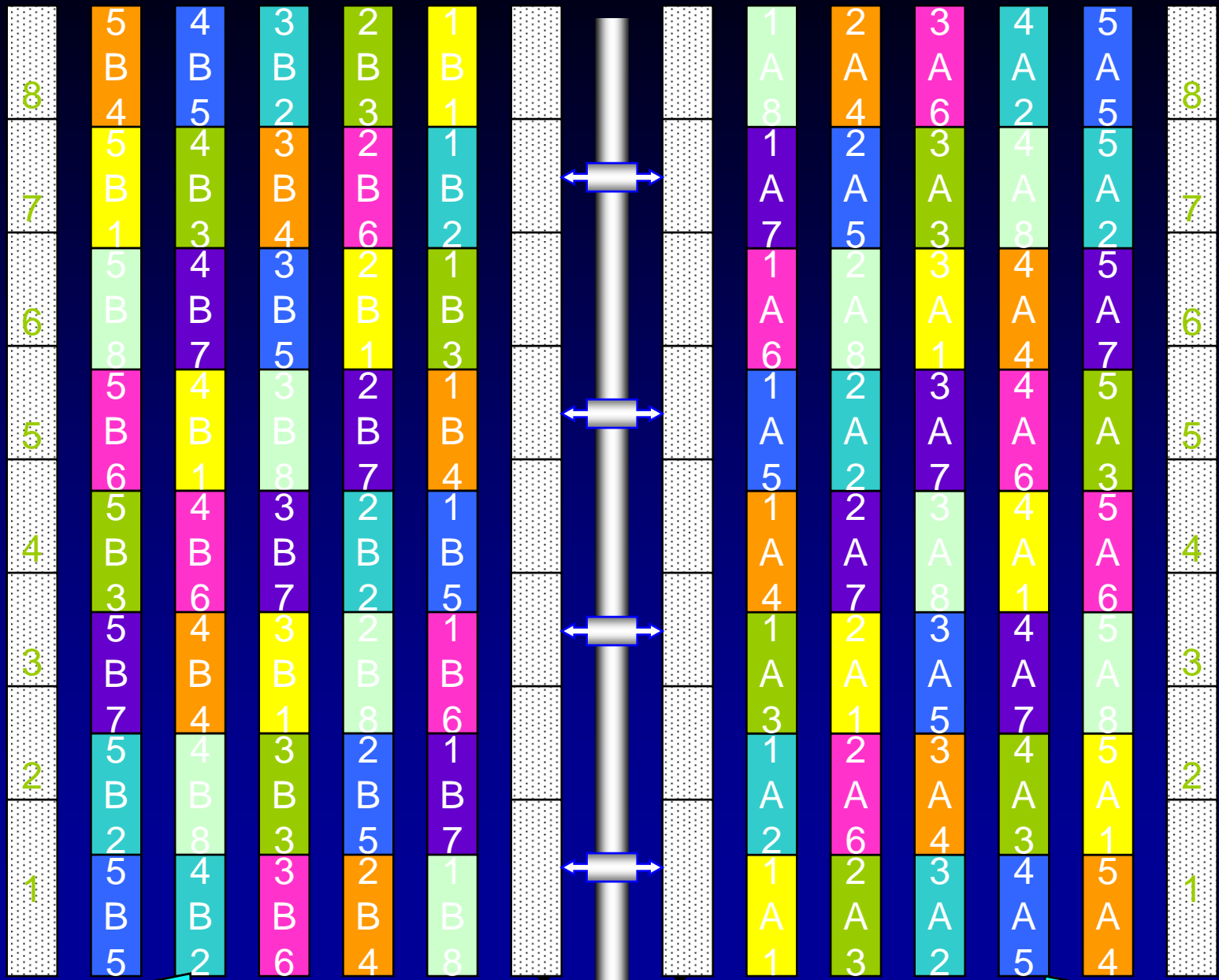
Field Trial 1

Objective: Evaluate generic E. coli survival in soil under different rates of sprinkler applied water

- **Replicated small plots (40-inch bed x 20 feet).**
- **Four E. coli treatments (water, soil, plant, combo.).**
- **Two concentrations (10^6 , 10^8 cfu/ml) each.**
- **Selected for antibiotic resistance (rif mutant).**
- **Sprinkler irrigated every 2 days (5 times total).**
- **Water volumes were measured.**
- **Monitor E. coli rif survival in soil.**

Field Trial 1



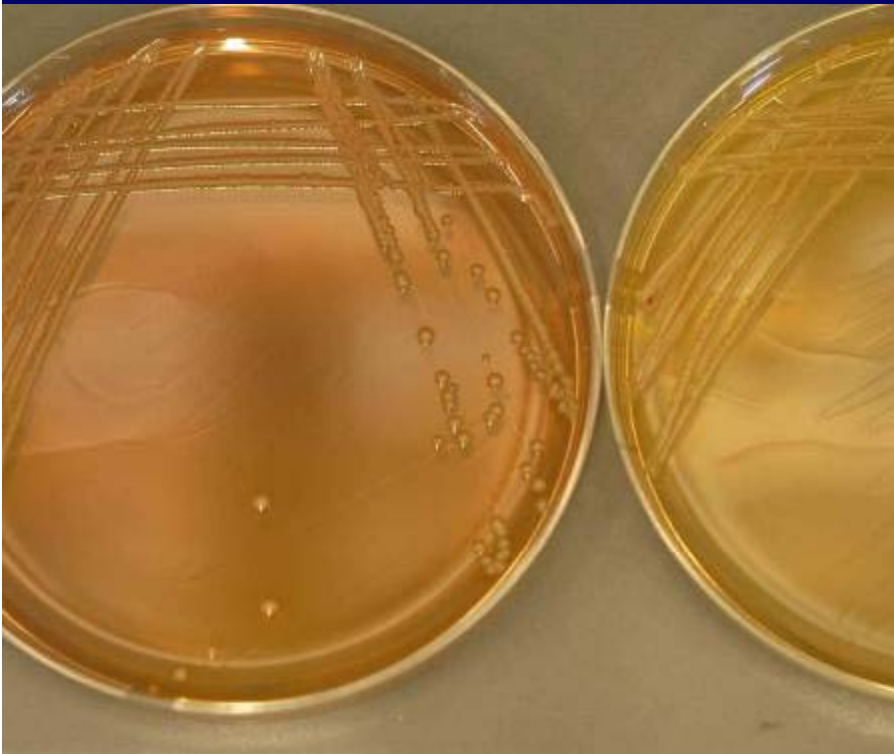
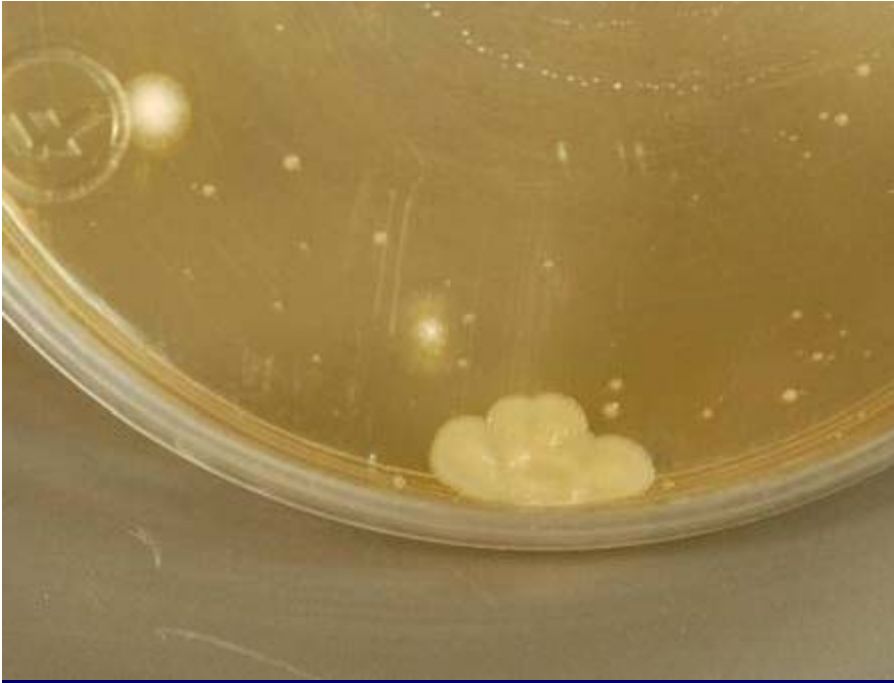


Sprinkler

Applied Water

Guard Row

Applied Water



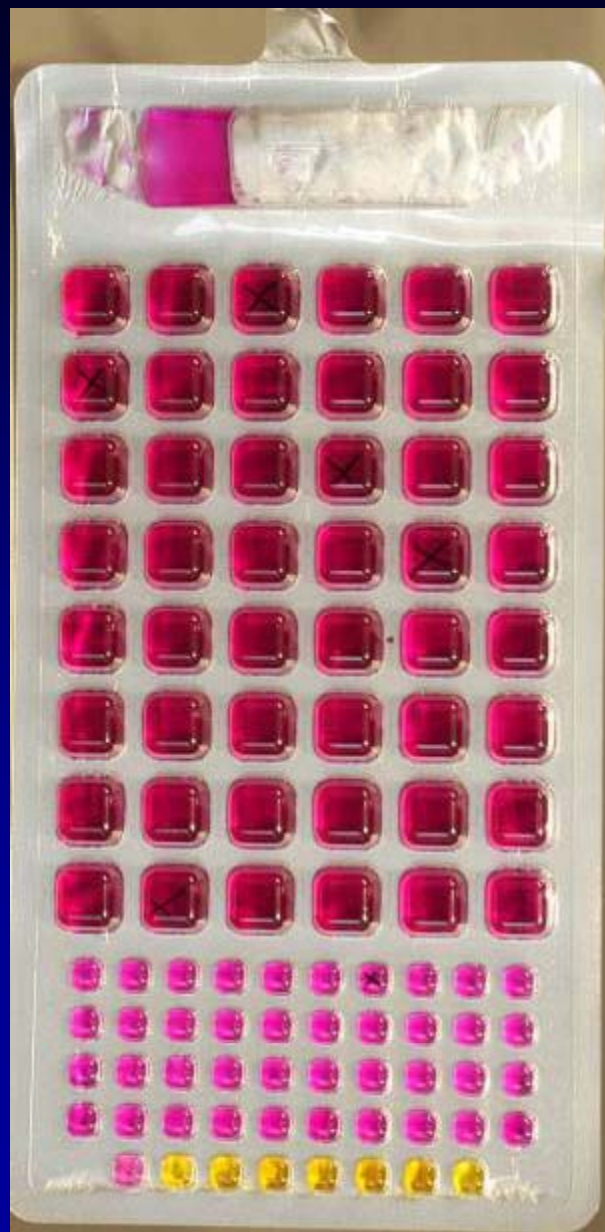
MUG

QuantiTray

Yellow = Neg.

Red = Coliform

UV = "E. coli"





The image shows two petri dishes side-by-side. The left dish contains a yellowish agar with numerous small, blue, circular colonies scattered across the surface. The right dish contains a pinkish agar with several long, thin, pinkish streaks of bacterial growth.

ECC

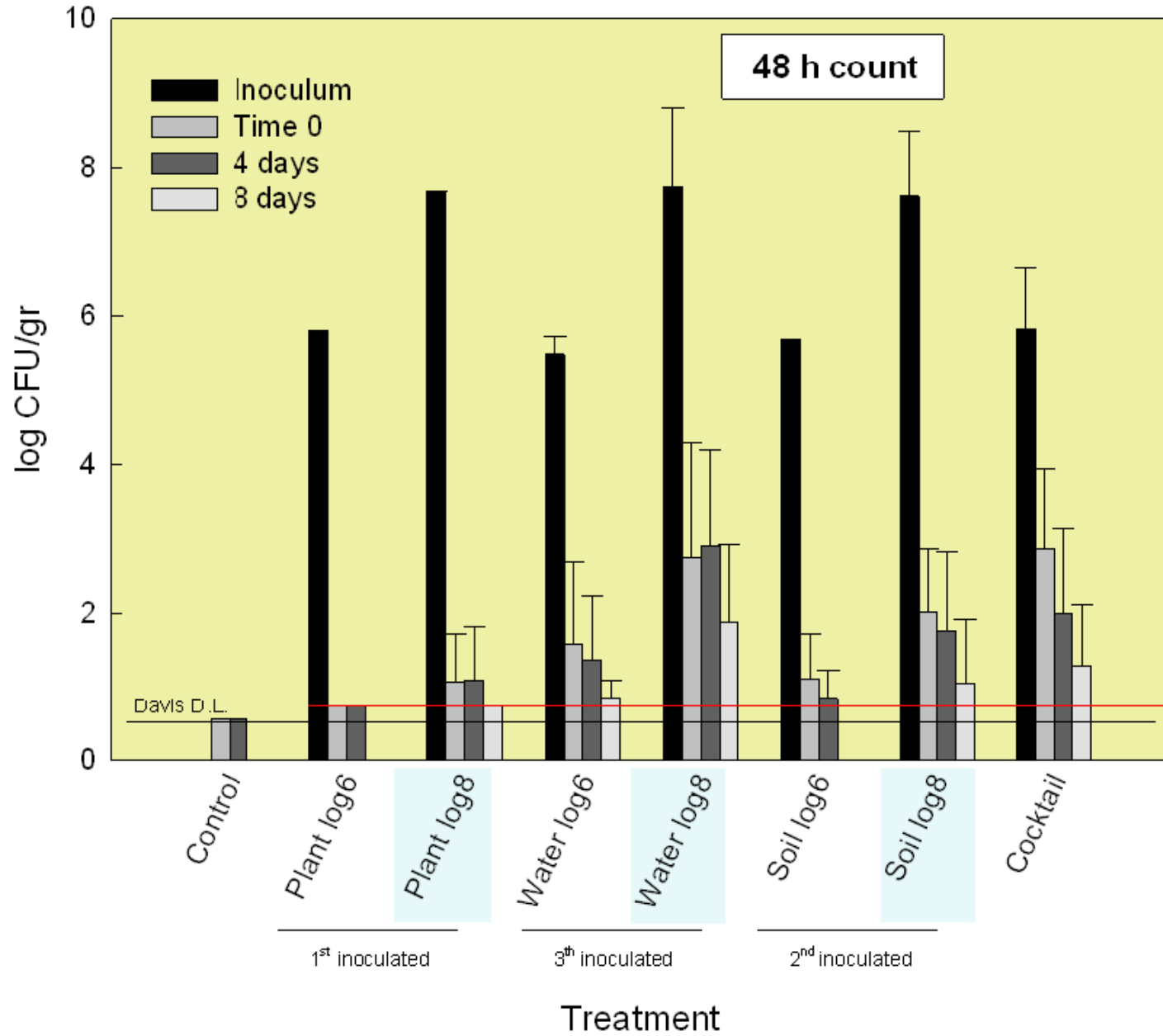
**Presumptive
E. coli**

Coliform

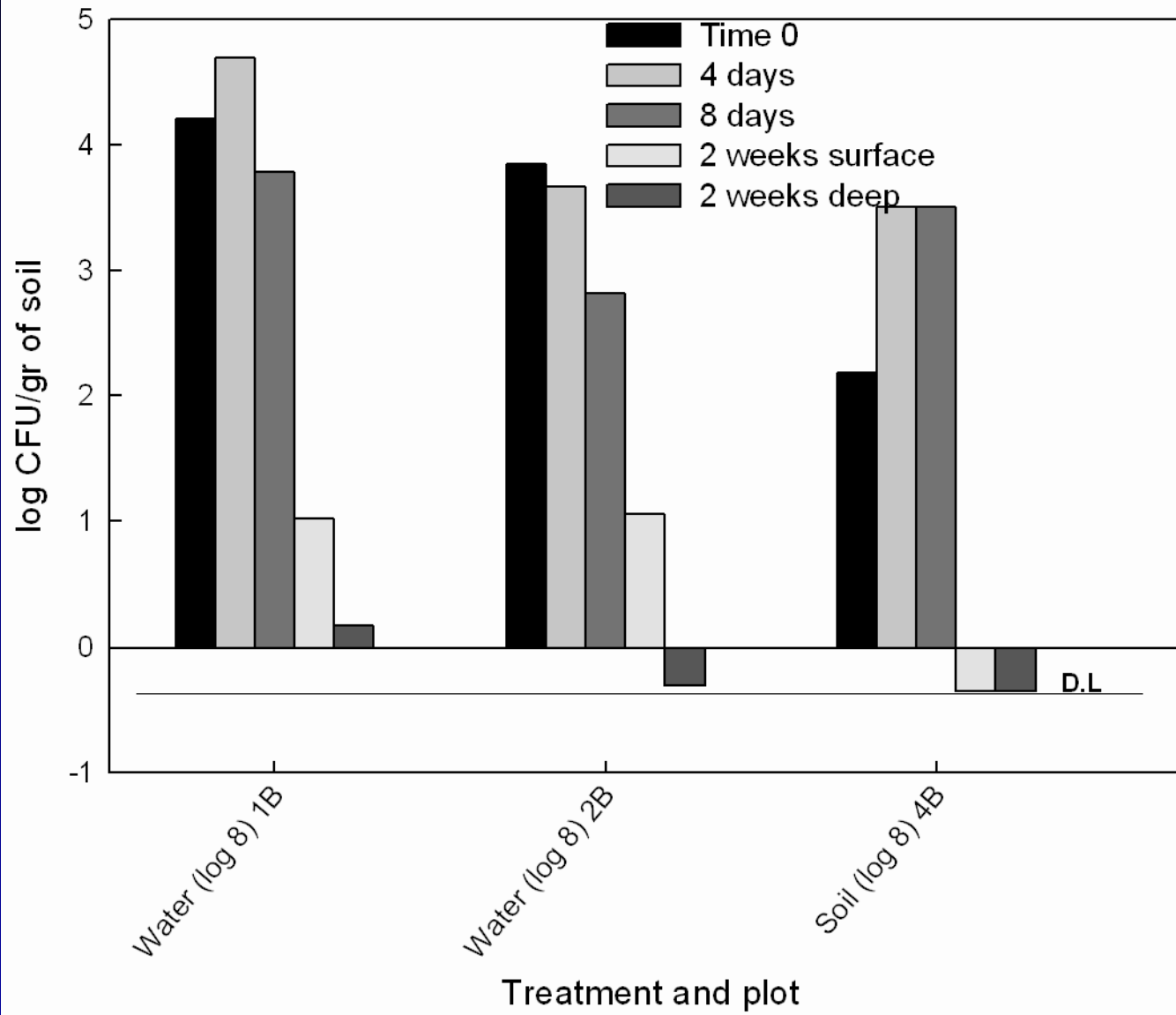
Field Trial 1 Results

- **E. coli rif recovered from soil up to 8 days.**
- **By 14 days, E. coli rif no longer detected (w/ exception of two plots).**
- **Higher recovery rates associated with the larger amounts of applied water.**
- **Applied strains were never detected in adjacent uninoculated plots.**

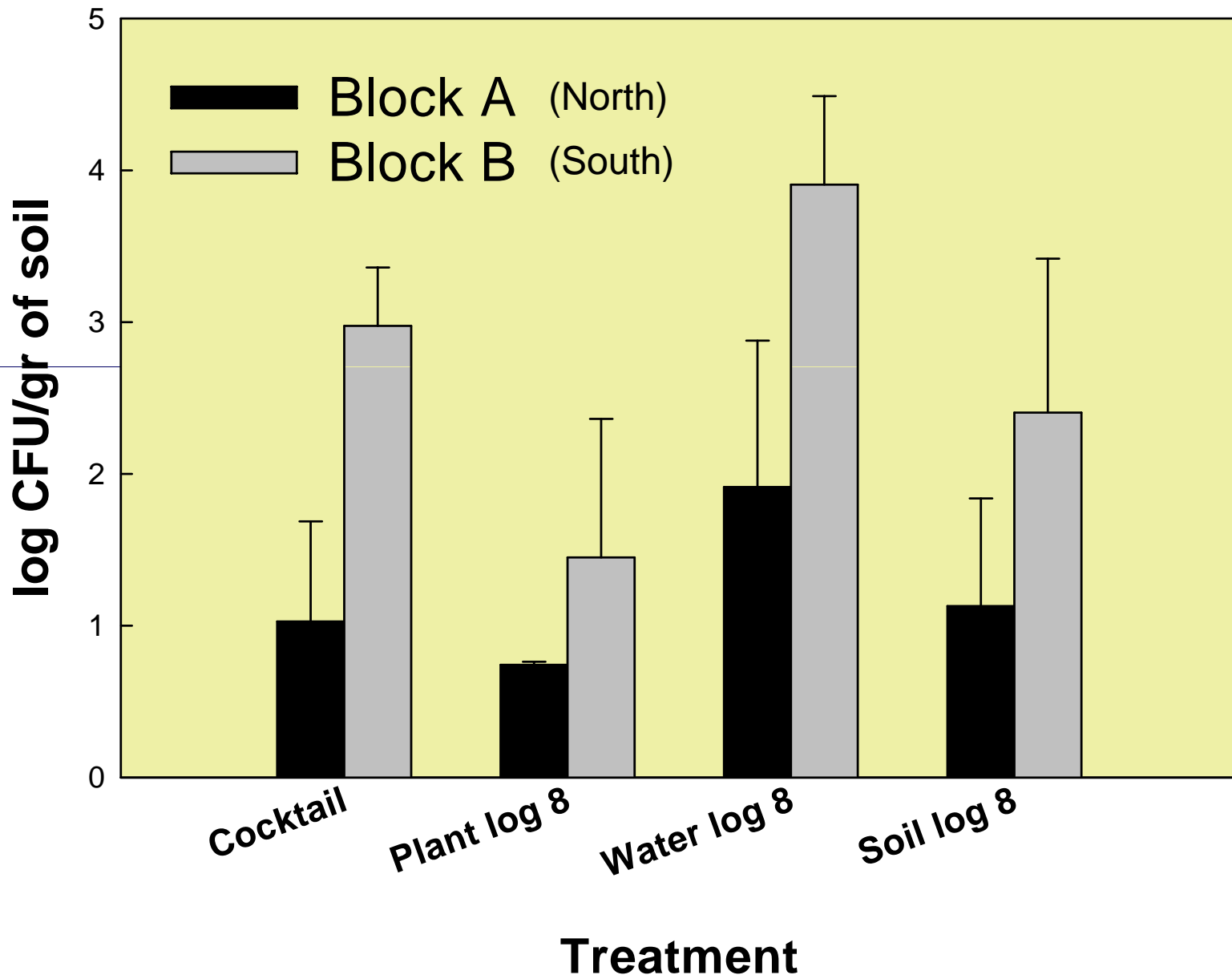
Field Trial 1



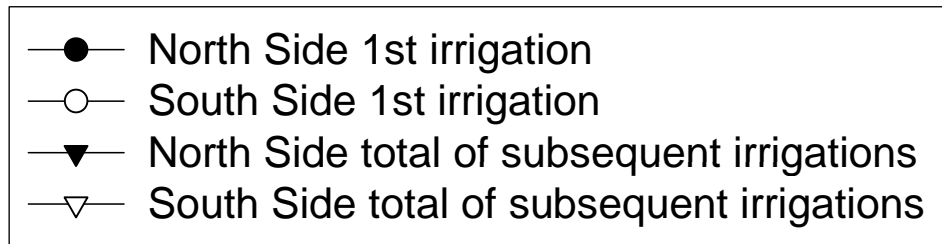
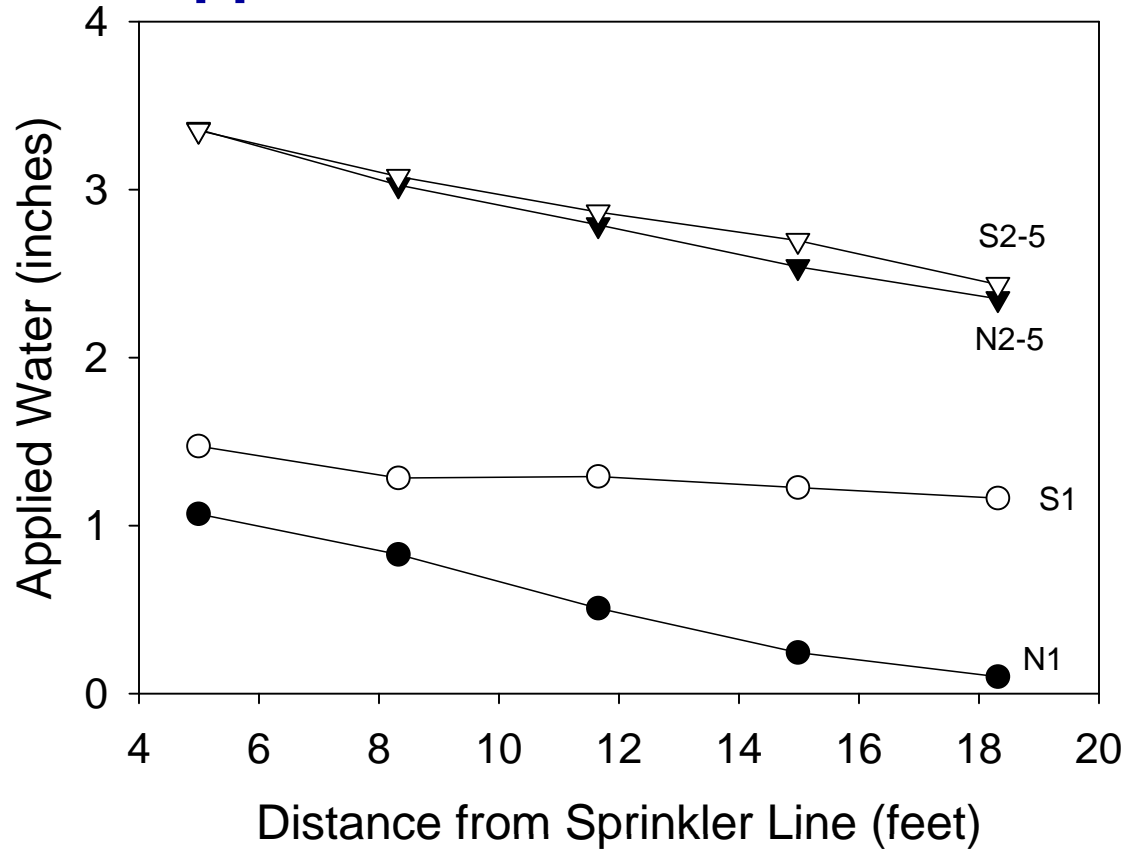
Individual Plots: Field Trial 1



Block A & B differences



Applied Water at Field Trial 1



Field Trial 2: Field SVR 51

Objective: Compare soil survival of generic E. coli under sprinkler/drip and with high/standard nutrient inputs.

- **Replicated large plots (three 40-inch beds x 145 feet).**
- **Treatments:**
 - **Irrigation: drip, sprinklers**
 - **E. coli rif (10^7): noninoculated, inoculated**
 - **Fertilizer: grower std, grower std + 350 lb N/acre + 250 lb P/acre**
- **Plant romaine; follow E. coli survival in soil, in runoff water (sprinkler plots only), on plants.**
- **Target lettuce harvest: September.**



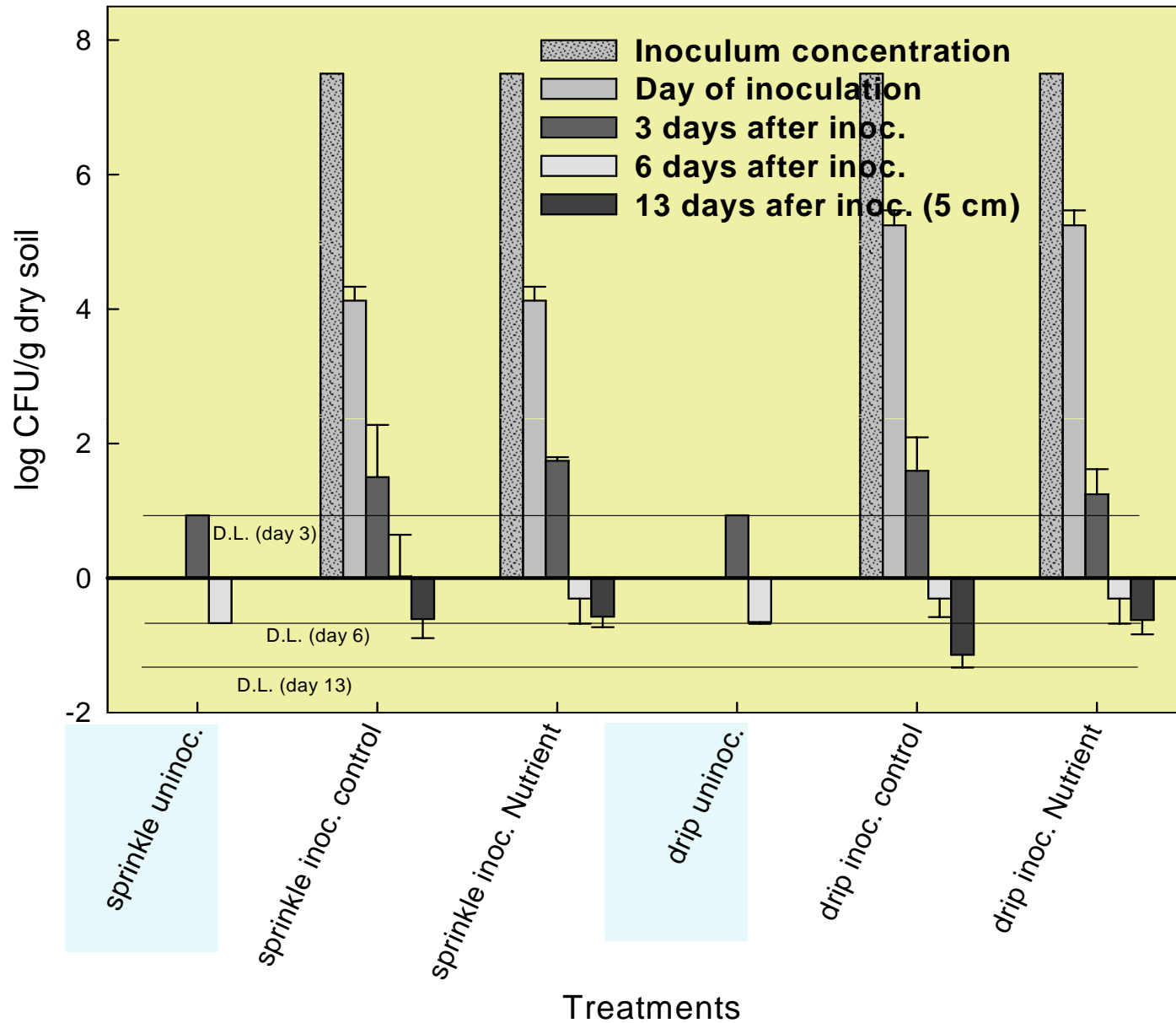




SVR 51 Results A

- **E. coli rif recovered from soil for only a short period of time (up to 3 days).**
- **Irrigation methods and nutrient levels had no effect on E. coli survival in soil.**
- **By 6 d, E. coli rif no longer detected.**
- **No detection of E. coli rif on lettuce:**
 - **seedling roots and rhizosphere soil**
 - **seedling leaves**
 - **larger plant leaves**
 - **plants of harvestable size**

E. coli survival in soil

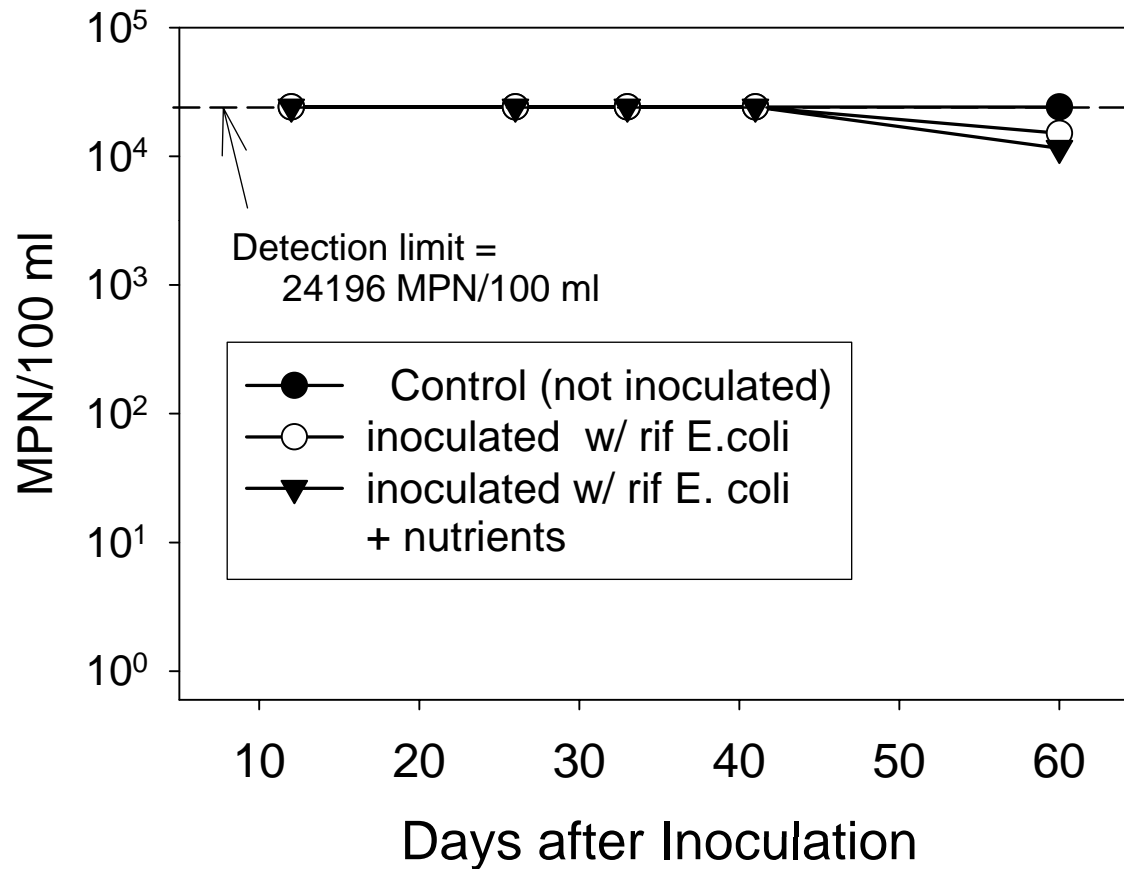


Day 0, 3 and 6. Samples were collected at the north side of each plot.
 Day 13. Samples consisted in a composite from 10 sub-samples distributed along the plot
 Data only from Davis analysis

SVR 51 Results B

- **Sprinkler irrigation runoff: E. coli rif detected up to 12 days after inoculation.**
- **E. coli rif strains were not detected in adjacent uninoculated plots/lettuce.**
- **Coliform bacteria were recovered from runoff for the duration of the trial.**

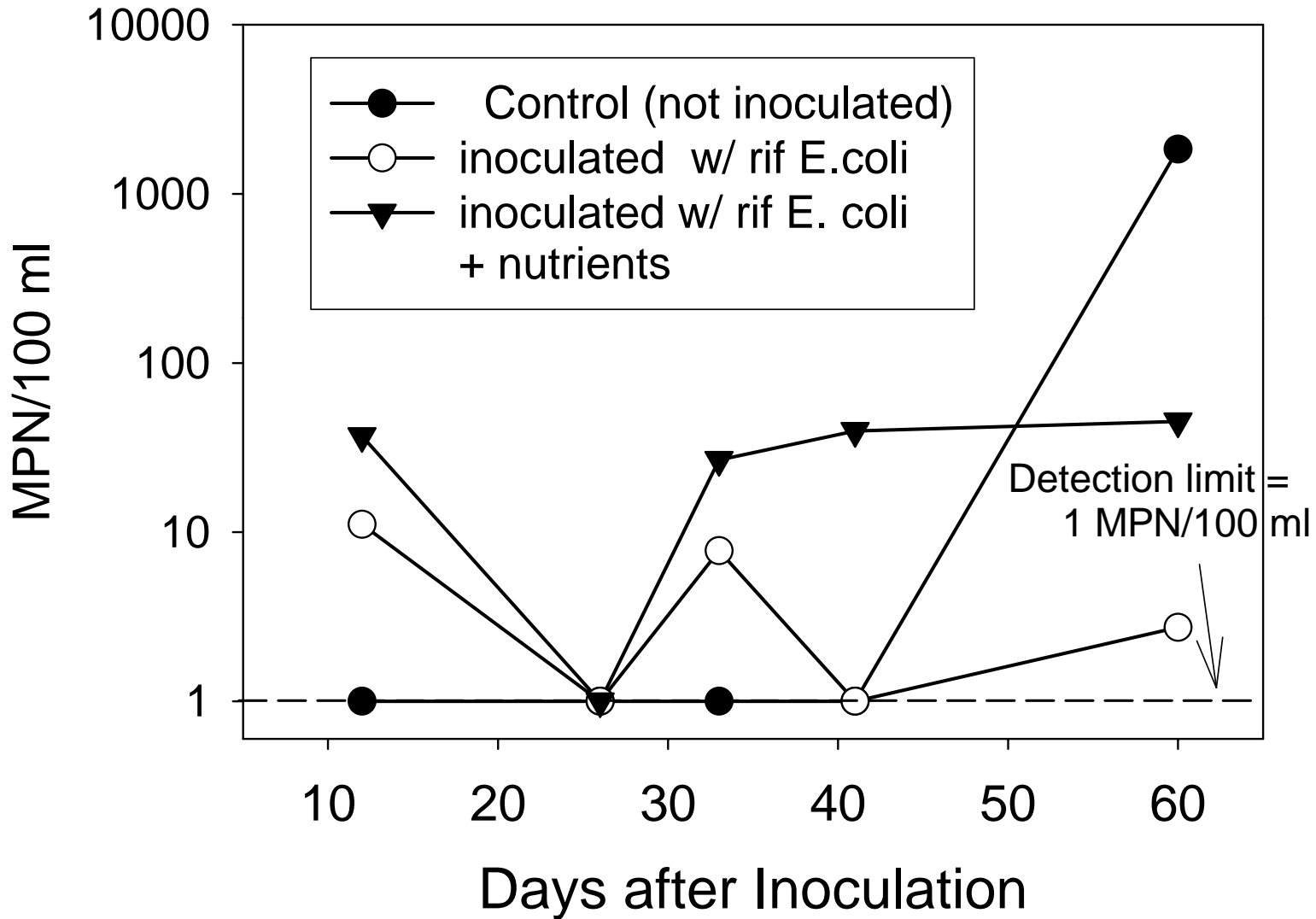
Coliform Bacteria in Sprinkler Run-off from SRV 51 field trial



SVR 51 Results C

- Starting from 26 days post inoculation, we recovered presumptive *E. coli* (growth on rif medium; fluorescence on MUG medium) from plants and runoff from inoculated plots.
- Late in experiment: found presumptive *E. coli* from uninoculated plots.
- However, all these isolates were later found to be false positives (ID= *Enterobacter* species).

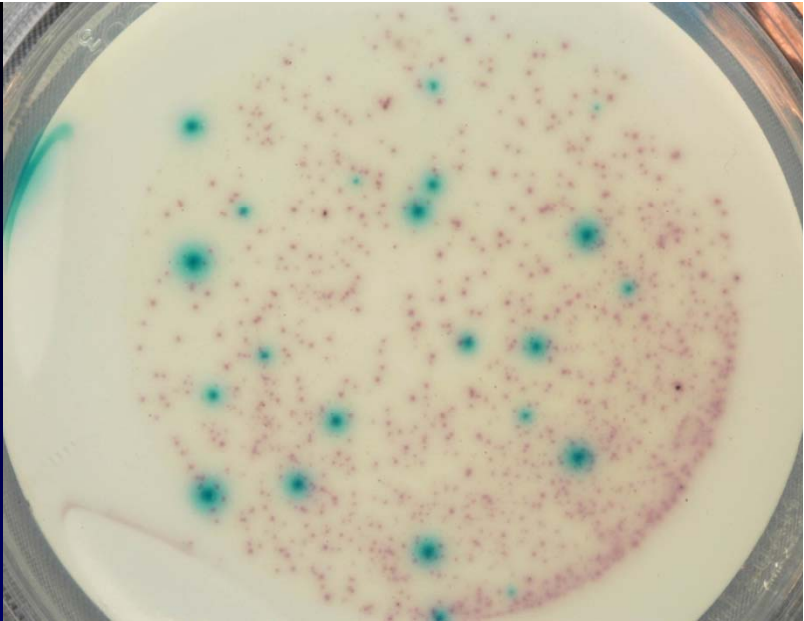
Presumptive E. coli in Sprinkler Run-off from SRV 51 field trial



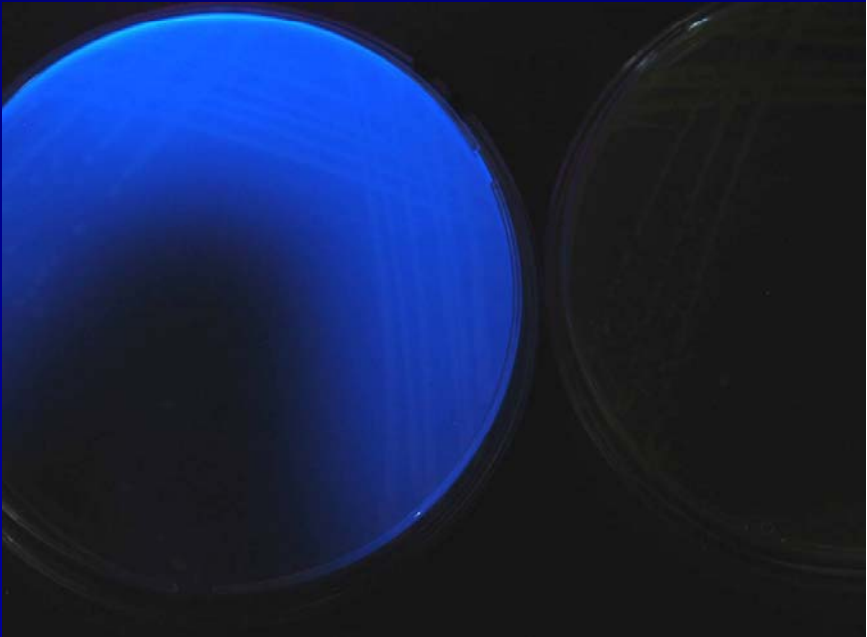
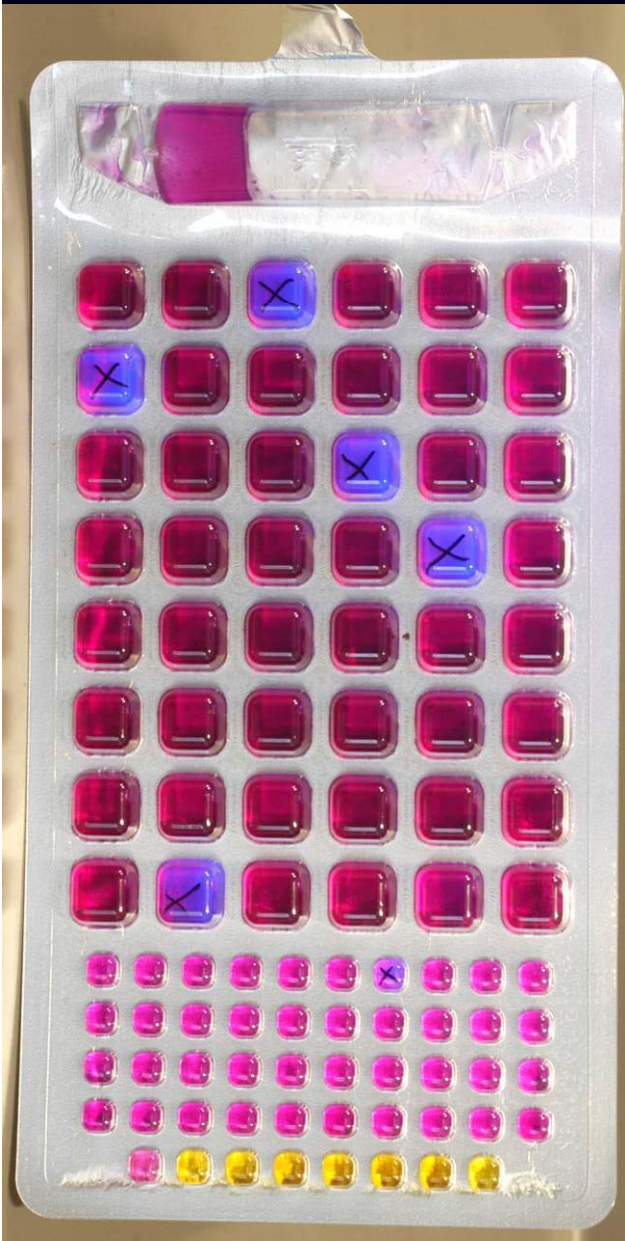
Summary for Generic E. coli in Field Studies

- Simulation of a one-time, high level contamination event (w/ E. coli rif) resulted in very short persistence.
- Irrigation method/nutrient level did not affect survival of E. coli in soil or in plant tissue.
- Presumptive E. coli was detected in sprinkler run-off water collected from furrows.
- Water appears to play key role in survival.
- Testing issue raised: positives with non-E. coli on ECC, TSA, QuantiTray assays?

?



E. coli or not E. coli?



E. coli in Irrigation Run-off and Creeks East-side Salinas Valley (9/6/07)

Bacterial TMDL proposed for the Lower Salinas Valley surface water:

Site	Description	Conf. m MPN/100 ml	Presumptive Generic E. Coli
1	irrigation run-off high sediment load	> 24196	1300
2	irrigation run-off high sediment load	> 24196	770
3	creek (downstream from 2)	> 24196	435
4	irrigation run-off high sediment load	> 24196	1120
5	irrigation run-off high sediment basin	> 24196	62
6	road-side run-off (downstream from 5)	> 24196	135
7	creek	> 24196	1046
8	Irrigation run-off (clear)	> 24196	45
9	road-side run-off (downstream from 8)	> 24196	37
10	irrigation run-off high sediment load	> 24196	687

target for *E. coli* = 126 MPN/100 ml



**Source?
Carrier?**





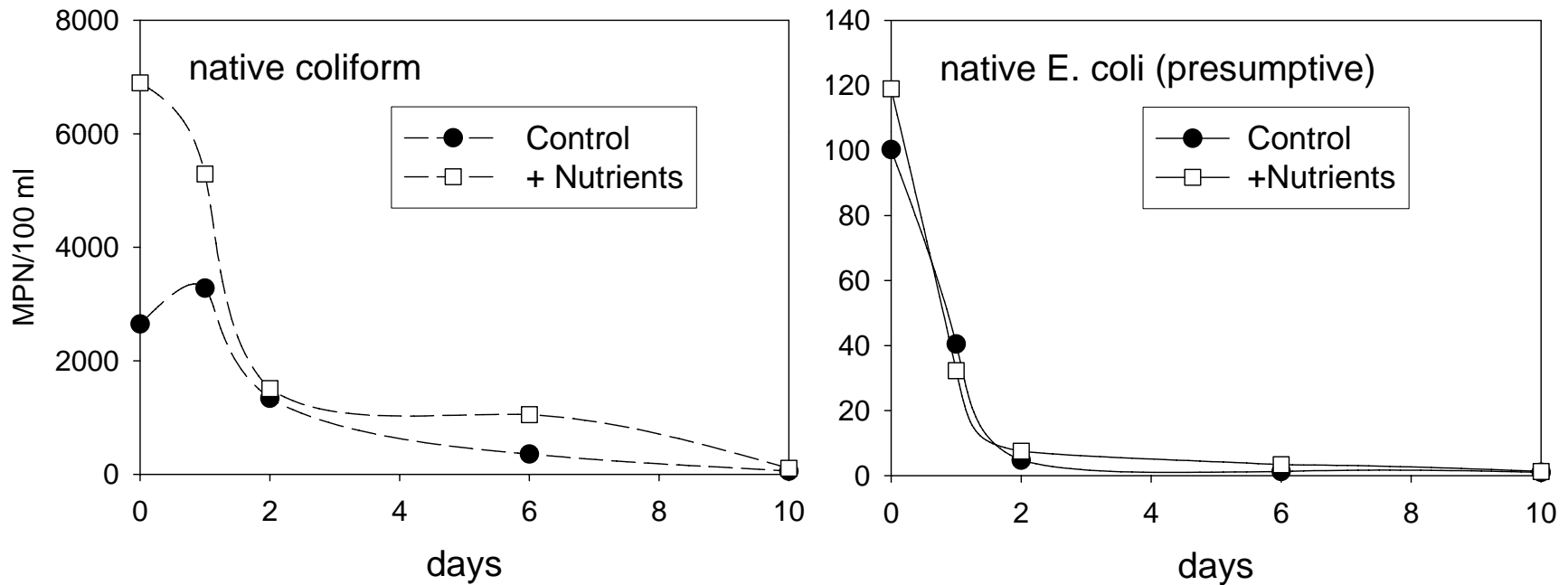


Acknowledgements:

- 1. California Lettuce Research Board**
- 2. Grower cooperators**
- 3. Research team: Patty Ayala, Elena Castro, Carol D'lima, Riley Hathaway, Kat Kammeijer, Eric Lauritzen, Salvador Montes, Lisa Quon, Adrian Sbodio, Arnett Young**

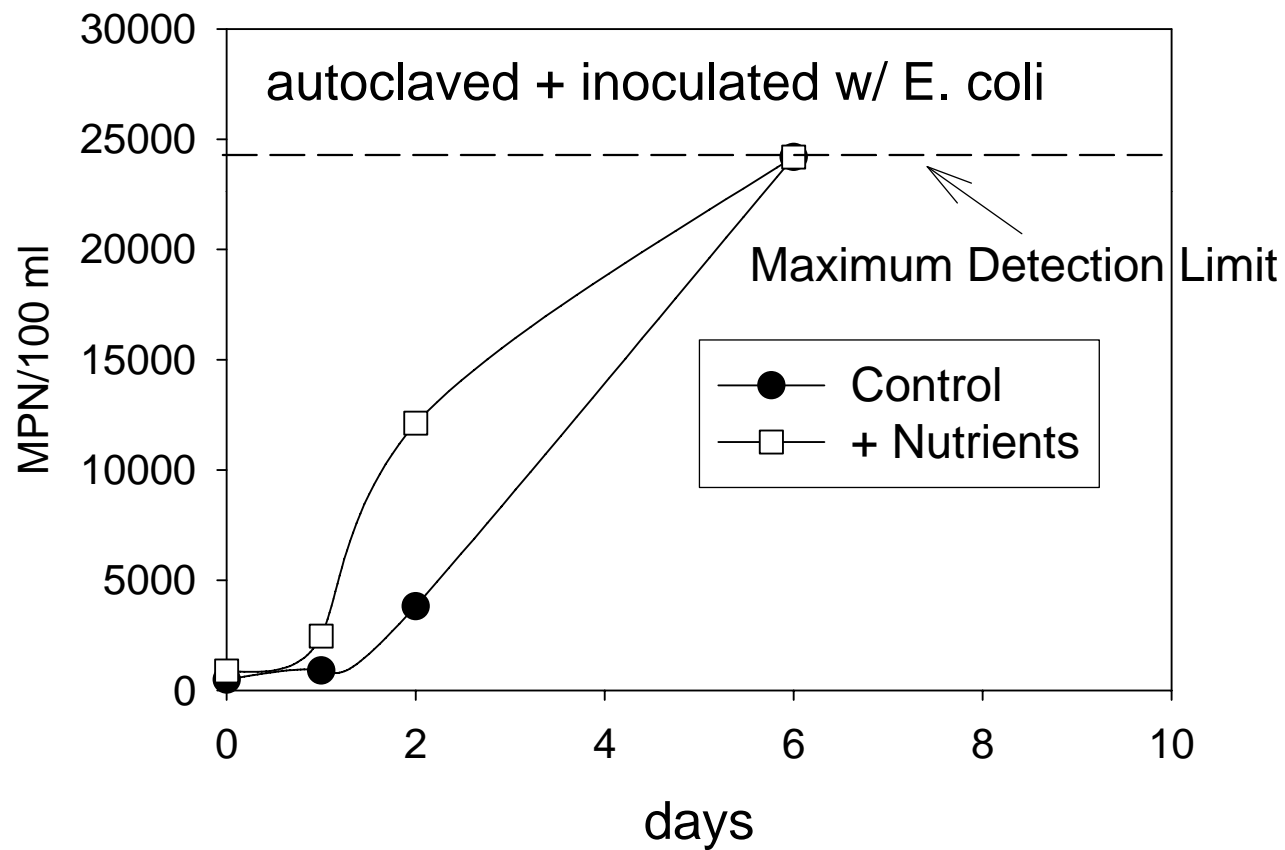


Effect of Nutrients* on native Coliform Bacteria and Presumptive *E.coli* levels in Creek Water (site 3)



*50 ppm Nitrate-N, 10 ppm orthophosphate

Effect of Nutrients* on Presumptive *E. coli* levels in autoclaved Creek Water (site 3)



*50 ppm Nitrate-N, 10 ppm orthophosphate