

Survival of Zoonotic Pathogenic Bacteria in the Agroecosystem

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Background



Objectives

- ❖ Measure survival characteristics of zoonotic pathogens using sentinel chambers (Jenkins et al.) in the environment of a dairy farm.

Salmonella enterica

field soil

in

dairy effluent lagoon

E. coli O157:H7

composted manure solids

- ❖ In laboratory, determine if pH adjustment can modify deactivation of *Salmonella* ser. Newport inoculated into dairy manure.

Materials and Methods

Field study 1, pathogen strain survival

- ❖ Sentinel chambers 3 cm sections of PVC pipe, ends sealed with 0.22 μm filter membranes.
- ❖ Sentinel contents were sieved, moist silt loam soil mixed with dairy manure, inoculated with pathogens.
- ❖ Soil-manure mixture inoculated with 10^7 g^{-1} *Salmonella* ser. Dublin, Newport or Typhimurium; *E. coli* *stx*+, *stx*- or *stx*+ streptomycin resistant strains.
- ❖ Replicated sentinels arrays buried under grass sod.



Materials and Methods (cont'd)

- ❖ Sentinel contents diluted, plated on XLD agar (*Salmonella*) or sorbitol-MacConkey agar (*E. coli*).
- ❖ Direct plating until detection limit reached, then MPN analysis to monitor presence/absence.

Field study 2, survival in dairy farm environment

- ❖ Sentinels w. inoculated soil-manure mixture, *S. Newport* or *E. coli stx+*, under grass sod.
- ❖ Sentinels w. inoculated manure, in dairy manure solids compost pile and in effluent lagoon.

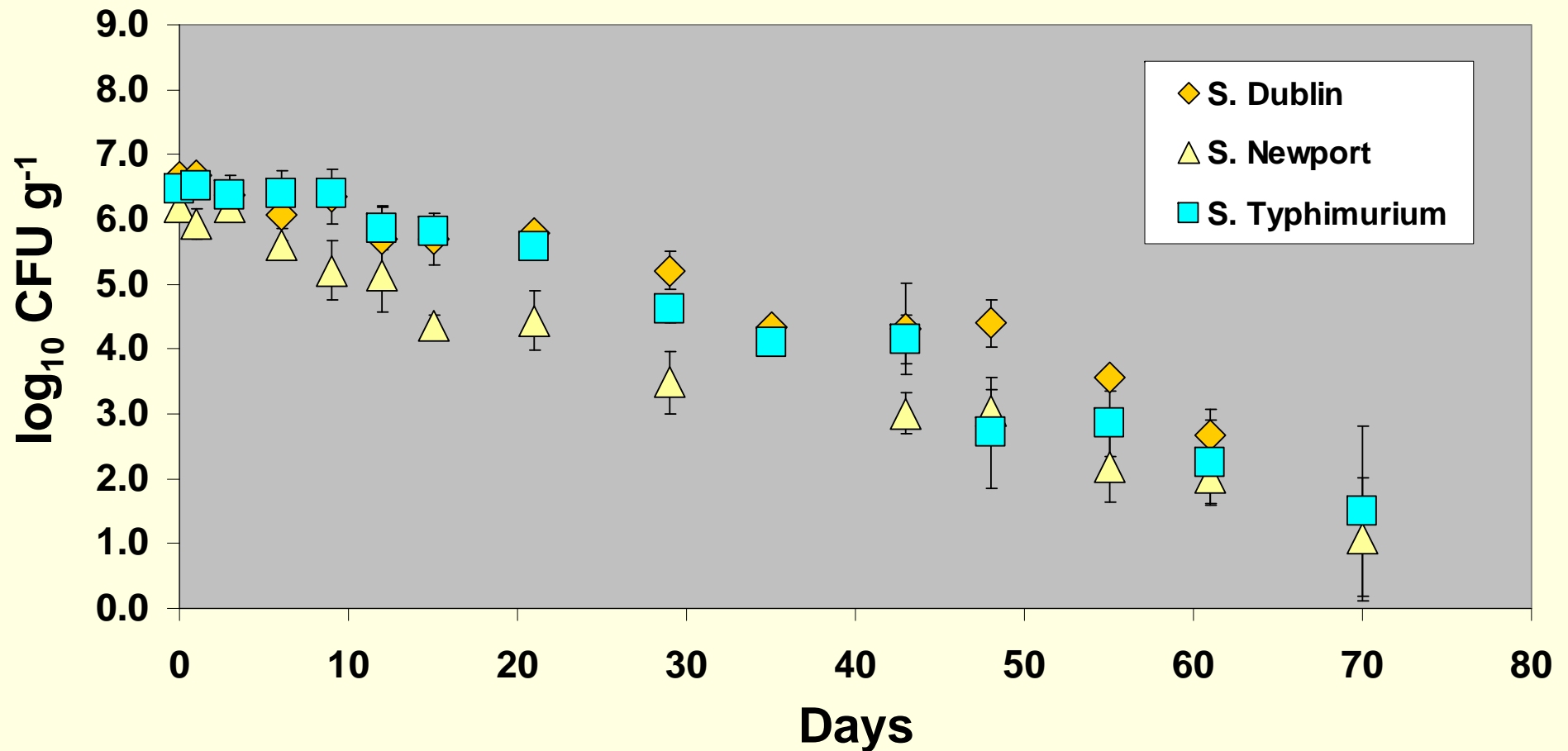


Materials and Methods (cont'd)

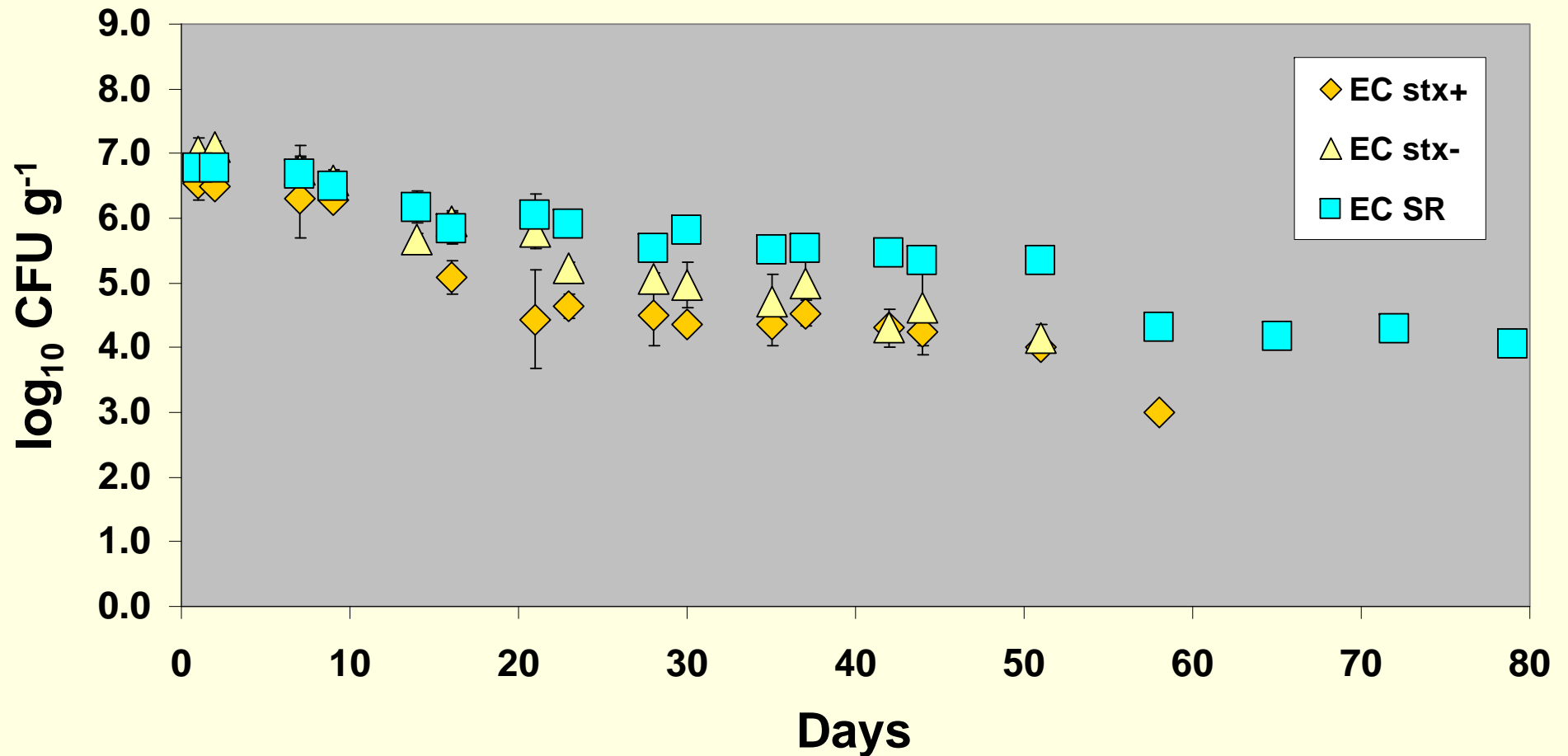
Laboratory pH studies

- ❖ 400 g dairy manure inoculated w. *S. Newport*.
- ❖ Increase pH with $\text{Ca}(\text{OH})_2$ addition to pH 8, 9 or 10; decrease pH with $\text{Al}_2(\text{SO}_4)_3$ to 4, 5 or 6, unamended circumneutral pH for reference, monitor pH changes and pathogen deactivation.

Survival of 3 strains of *S. enterica* in field soil, April-June



Survival of 3 strains of *E. coli* O157:H7 in field soil, April-June



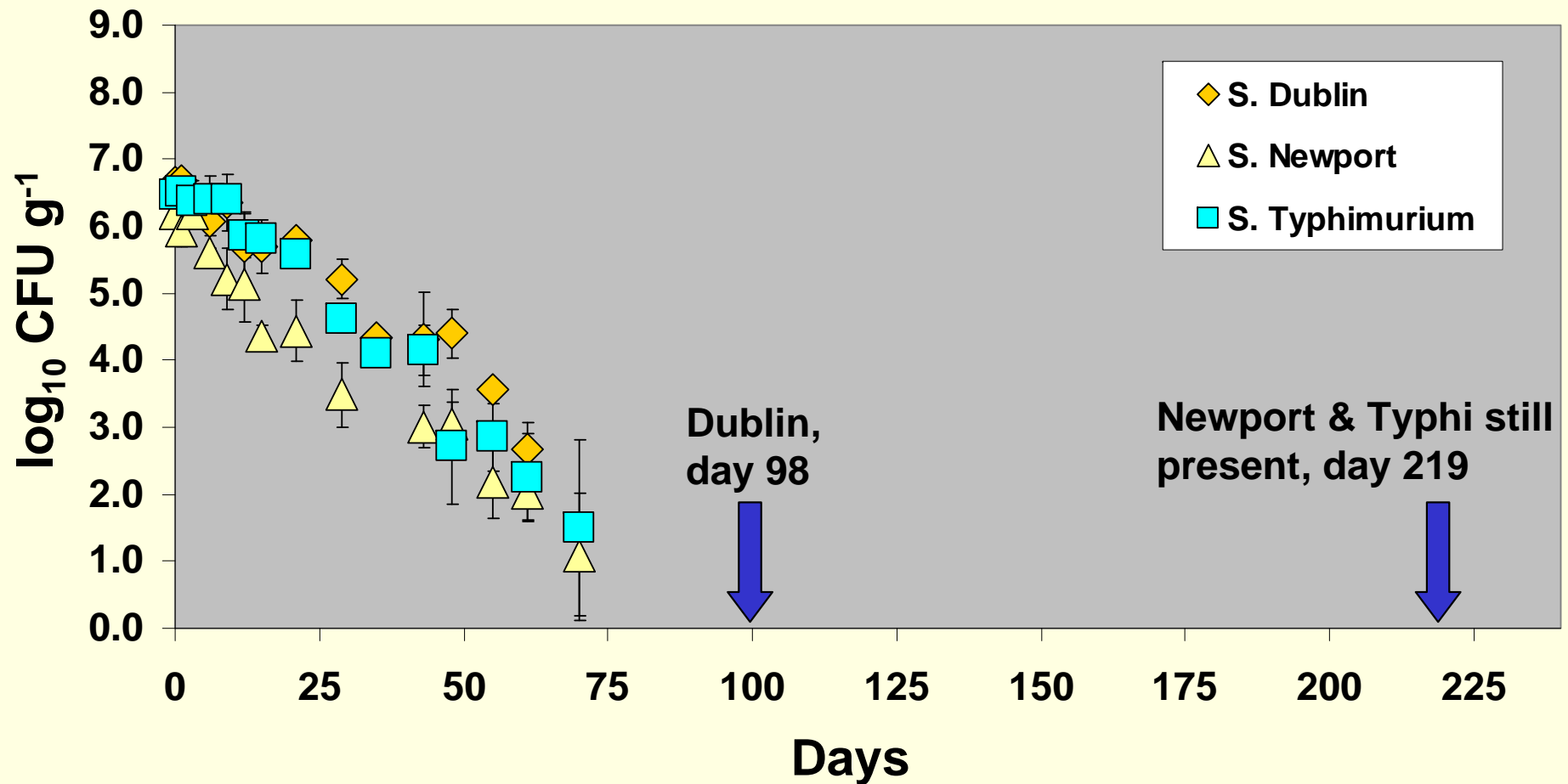
Pathogen survival parameters, strain survival study

Serovar/strain	Log reduction time (days)	Max. survival time (days)
S. Dublin	17.5	<117†
S. Newport	15.8	>219
S. Typhimurium	14.6	>219
<i>E. coli stx+</i>	19.6	<65‡
<i>E. coli stx-</i>	16.4	<58
<i>E. coli stx+</i> SR	45.4	>79

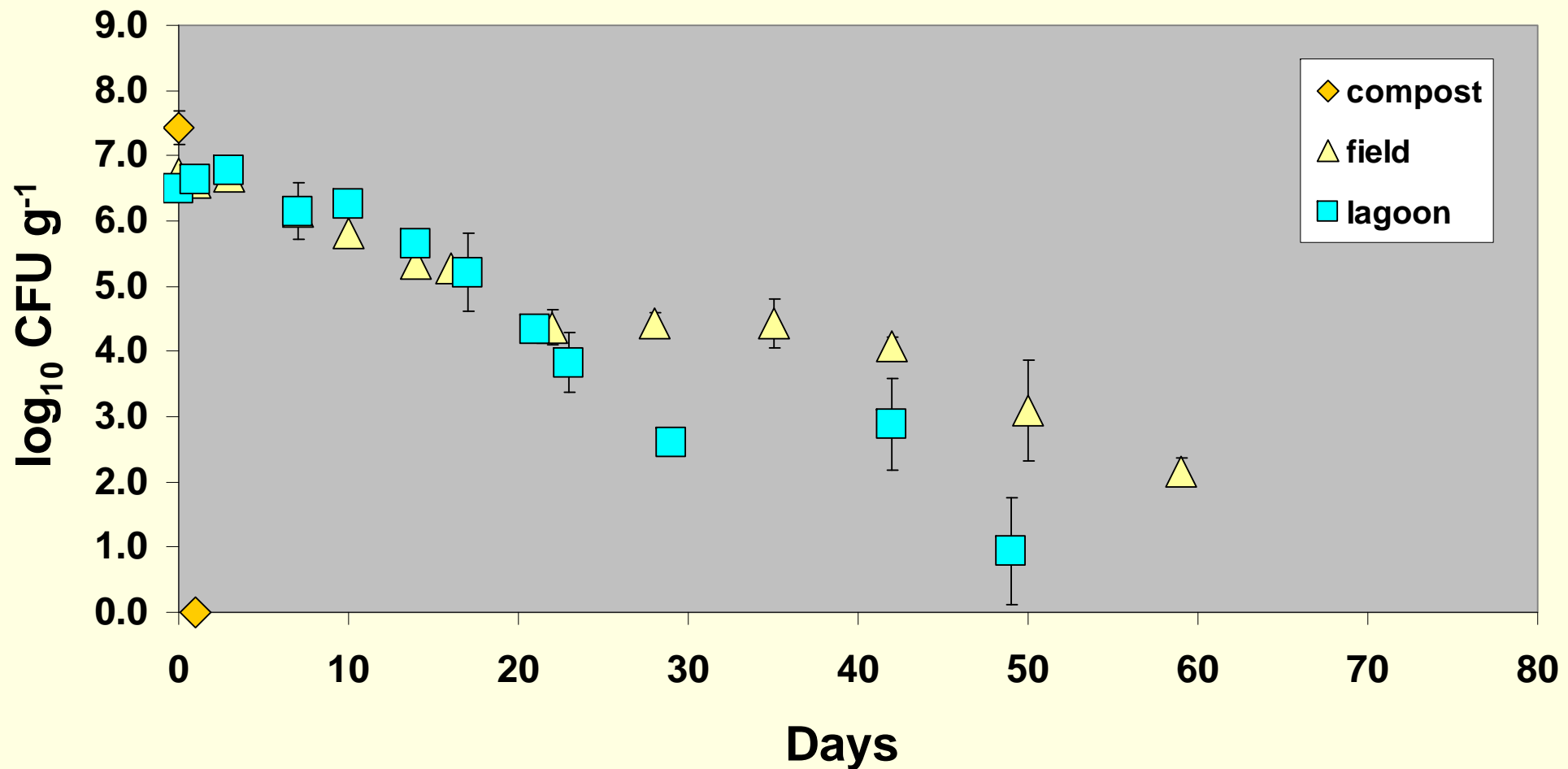
† determined by MPN analysis

‡ determined by direct plating

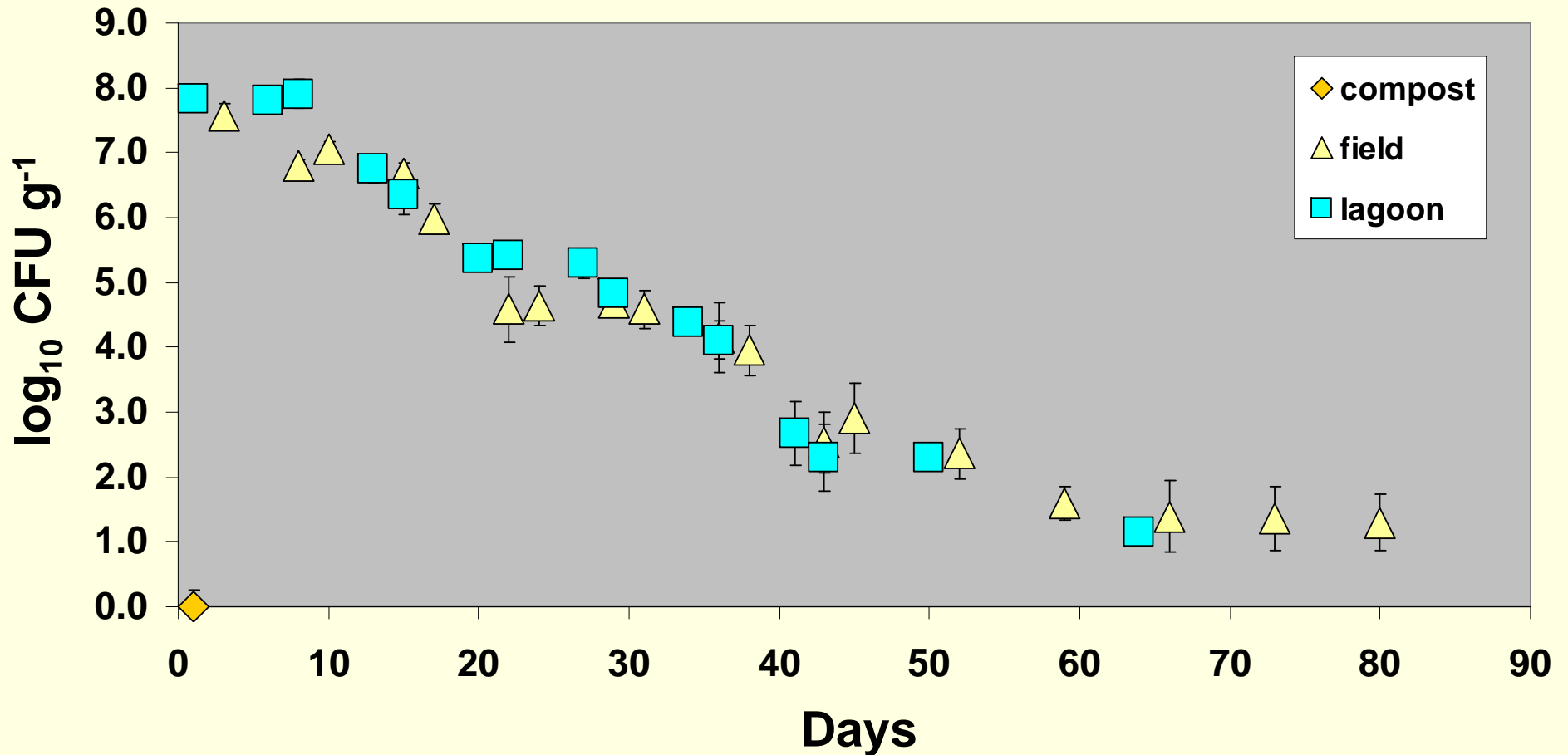
Salmonella strain survival, direct plating results vs. duration of detection by MPN



Survival of *S. Newport* in composted dairy manure solids, field soil and effluent lagoon, June-August



Survival of *E. coli* O157:H7 in composted dairy manure solids, field soil and effluent lagoon, June-August



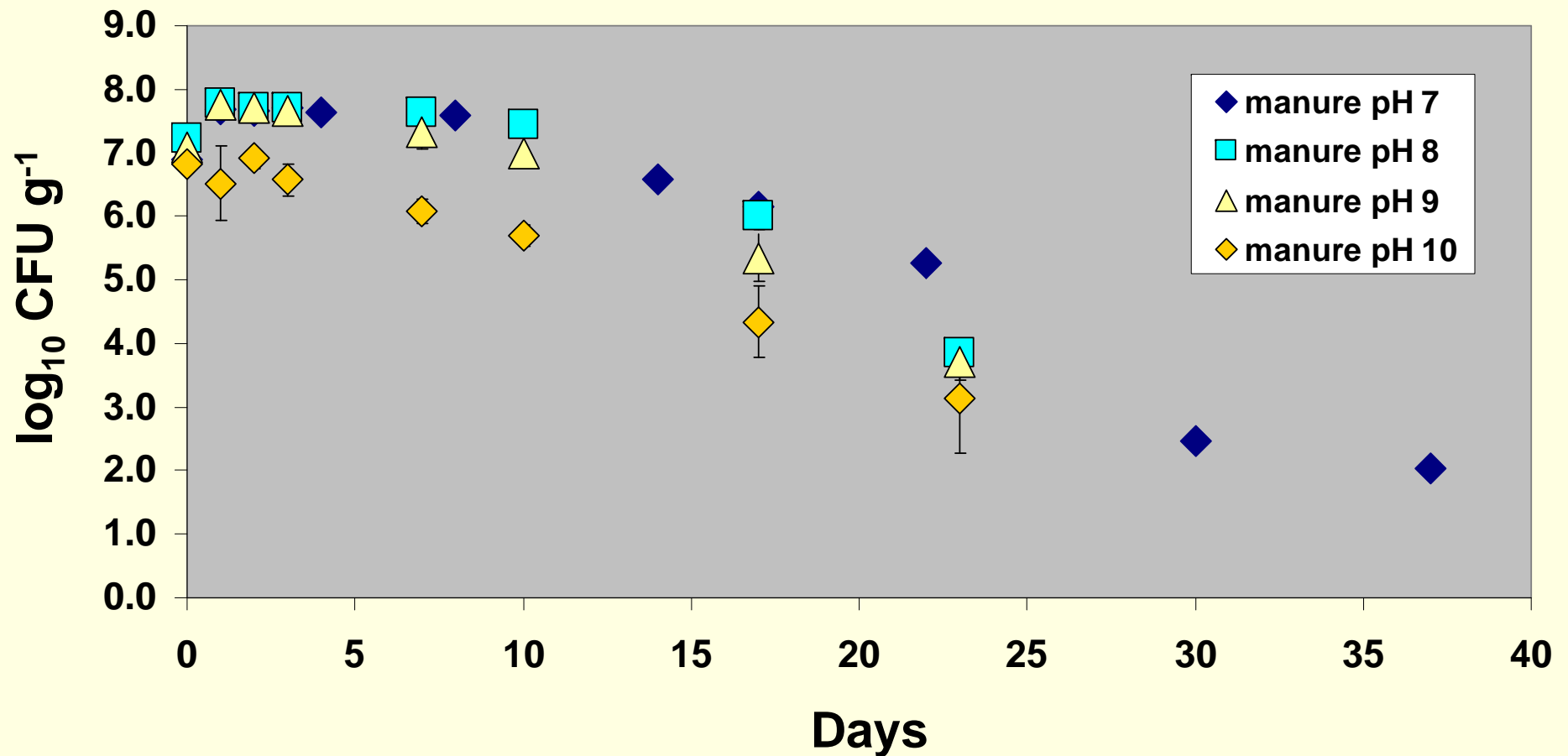
Pathogen survival parameters, dairy farm environment study

Type/Location	Log reduction time (days)	Max. survival time (days)
<i>S. Newport</i> in compost	-	<1
in field soil	14.3	>130†
in lagoon	7.7	>137
<i>E. coli stx+</i> in compost	-	<1
in field soil	10.6	>80‡
in lagoon	8.1	<71

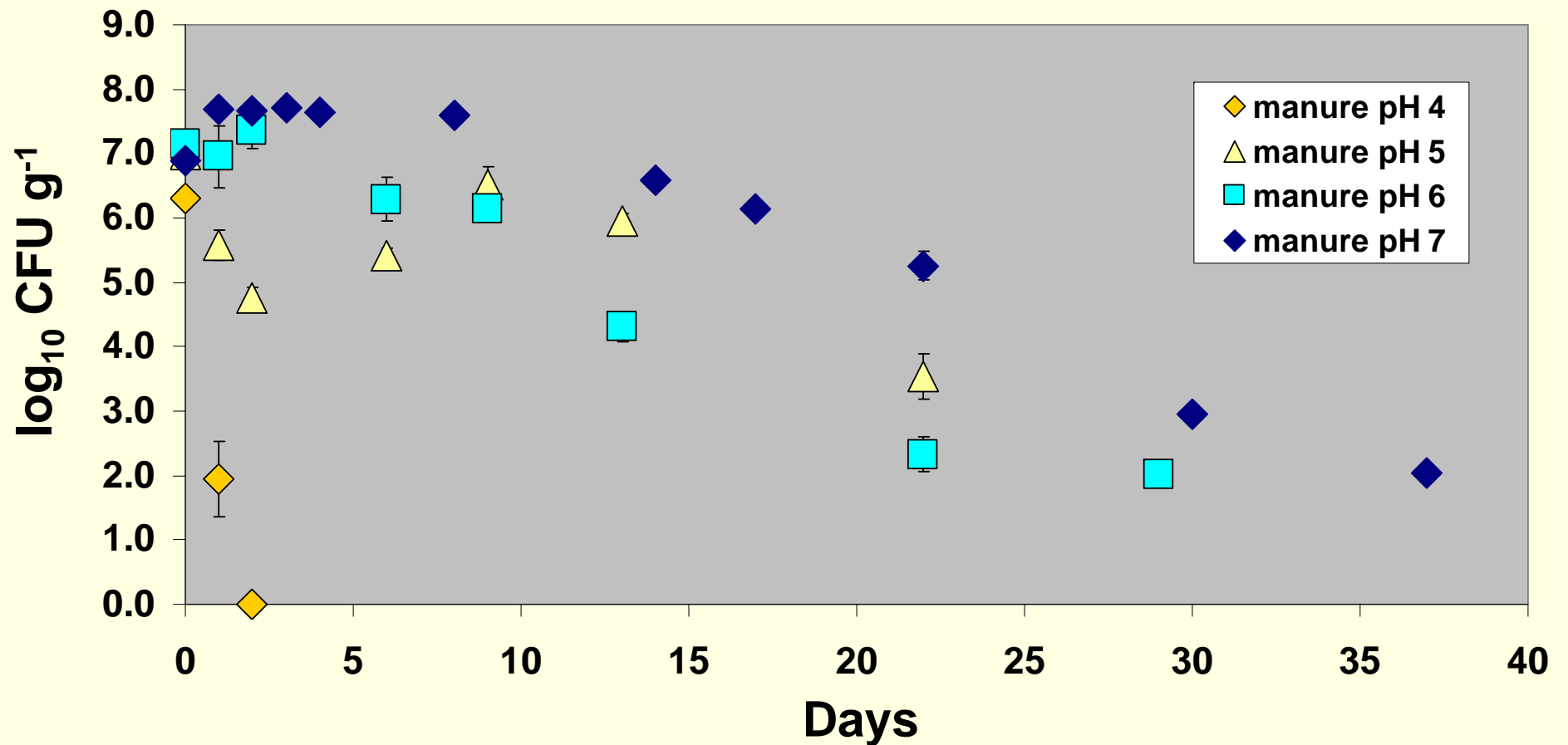
† determined by MPN analysis

‡ determined by direct plating

Survival of *S. Newport* in dairy manure, with pH adjustment



Survival of *S. Newport* in dairy manure, with pH adjustment



Conclusions

- ❖ Calculated log reduction time for *Salmonella* serovars and *E. coli* O157:H7 generally on the order of 15-20 days in field soil and 8 days in dairy effluent lagoon.
- ❖ However, pathogens were shown to persist at low concentrations for >7 months.
- ❖ High temperatures generated in compost deactivated *Salmonella* and *E. coli* in <24 hrs.
- ❖ Except at pH 4, pH adjustment not very effective at reducing *Salmonella* survival over the short term.