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PATHOGENS IN ANIMAL MANURES: THEIR SURVIVAL DURING STORAGE AND FOLLOWING LAND APPLICATION

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INTRODUCTION

Animal manures are a valuable source of plant available nutrients and organic matter, contributing to soil quality and fertility. Around 90 million tonnes (fresh weight) are recycled annually to agricultural land in the UK representing the most economic, practical and environmentally beneficial management option in most cases. However, manures can contain pathogenic microorganisms which creates the potential for the spread of zoonoses from the farm environment into the food chain or aqueous environment. There is little quantitative information on the fate of manure pathogens during storage and following land application. This makes it difficult to assess whether current manure management guidelines, which are largely focused on reducing nutrient pollution, are appropriate for controlling the risks to food safety and water quality.

In this study, the survival of pathogens in animal manures during storage and following land application was investigated in a series of field scale experiments.

MATERIALS AND METHODS

In the storage studies, manures were seeded with commonly encountered pathogens (*E. coli* O157, *Salmonella, Listeria, Campylobacter* and *Cryptosporidium*). Slurries and dirty water were stored in 20 m^3 above-ground circular steel tanks (slurry), and solid manures were stored in 10 m^3 turned (composted) and unturned heaps. Samples were withdrawn at regular intervals over a 6-12 month storage period and pathogen decline curves were generated.

In the land spreading experiments, liquid and solid manures were seeded with pathogens as above. Manures were applied to a sandy textured arable soil at ADAS Gleadthorpe (Nottinghamshire, England) and incorporated into the soil using a spading machine. Manures were also surface applied to a clay loam grassland soil at ADAS Pwllpeiran (Wales). Pathogen survival was determined by testing soil cores (0-15 cm depth on the arable soil and 0-7.5 cm depth on the grassland soil) at regular intervals over a 9 month period. Soil and air temperatures, and rainfall were recorded throughout the field experiments.

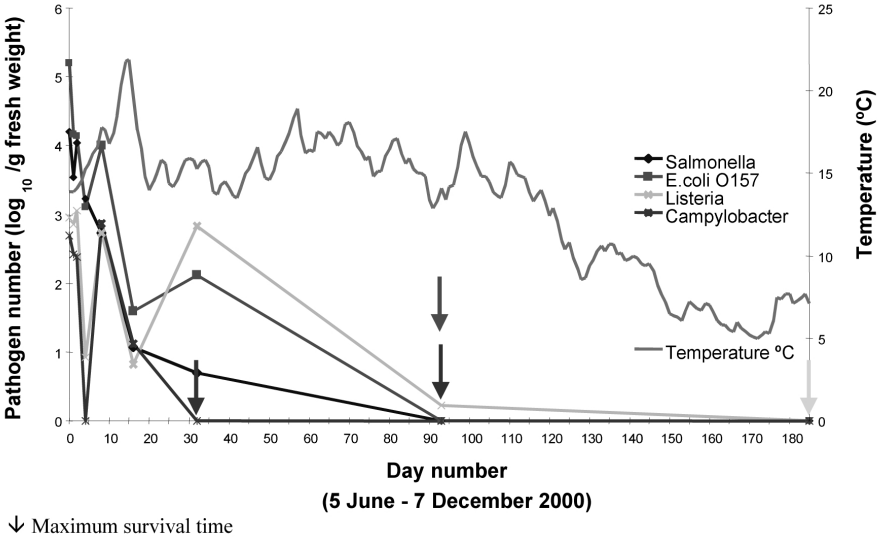
RESULTS

Manure storage

Initial results indicate that *E. coli* O157, *Salmonella* and *Campylobacter* can survive for

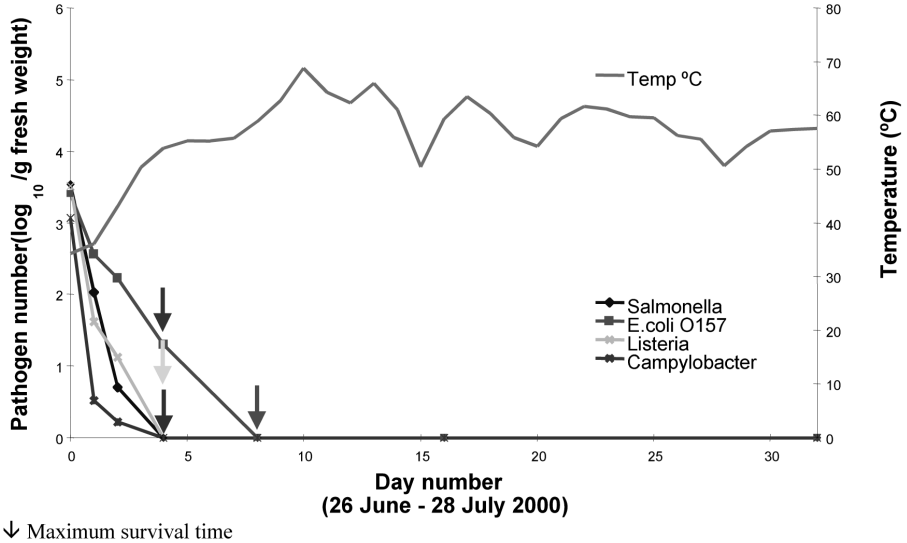
up to 3 months in batch stored dairy slurry and dirty water, where temperatures were generally <20°C (Figure 1). In contrast, pathogens could not be detected after c. 1 week where solid manure heap temperatures reached 60°C (Figure 2), Table 1.

Figure 1: Pathogen survival in stored dairy slurry



↓ Maximum survival time

Figure 2: Pathogen survival in unturned dairy FYM



↓ Maximum survival time

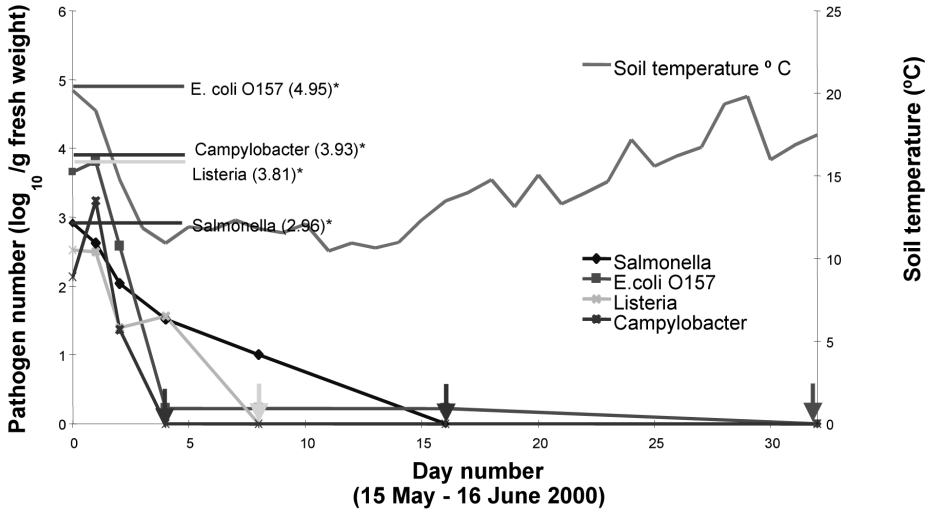
Table 1. Summary of maximum pathogen survival periods (days) during storage

Manure type	*E.Coli* O157	*Salmonella*	*Listeria*	*Campylobacter*
Dairy FYM – unturned	8	4	4	4
Dairy FYM – turned	4	4	4	2
Pig FYM – unturned	4	4	4	2
Pig FYM – turned	32	16	4	2
Broiler litter	4	4	8	4
Dairy slurry – 10% DM	32	32	185	32
Dairy slurry – 4 % DM	93	93	185	32
Dirty water	16	32	93	16

Land spreading

Preliminary results showed that *E. coli* O157, *Salmonella* and *Campylobacter* generally survived in the soil for up to 1 month after manure application to both the sandy arable and clay loam grassland soils (Figures 3 and 4, Table 2), with some indication that the pathogens survived longer in the clay loam grassland soil than in the sandy arable soil.

Figure 3: Pathogen survival in beef slurry spread on a sandy arable soil (ADAS Gleadthorpe)



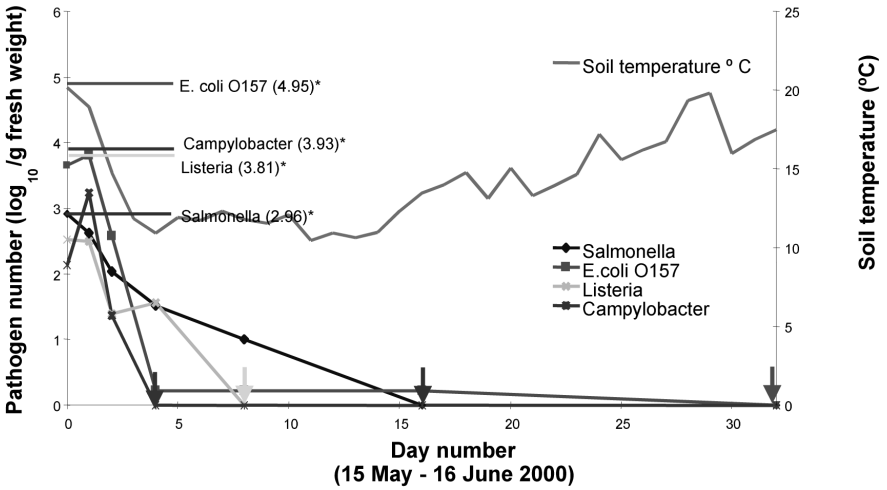
*Initial level in applied manure

⬇ Maximum survival time

DISCUSSION

These data will be used to assess the risk of pathogens from animal manures entering the human food chain or water systems, and the potential costs and environmental consequences (e.g. on ammonia and nitrous oxide emissions to air, nitrates leaching losses to water) of implementing practical measures to control pathogen spread from manures.

Figure 4: Pathogen survival in beef slurry spread on a clay loam grassland soil (ADAS Pwllpeiran)



*Initial level in applied manure
⬇ Maximum survival time

Table 2. Summary of maximum pathogen survival periods (days) following land spreading at ADAS Gleadthorpe and ADAS Pwllpeiran

Manure type	*E.Coli* O157	*Salmonella*	*Listeria*	*Campylobacter*
ADAS Gleadthorpe (sandy arable soil)				
Beef FYM	16	16	16	4
Dairy FYM	>32*	>32*	>32*	>32*
Pig FYM	16	16	8	4
Sheep FYM	32	32	32	4
Broiler litter	4	4	4	4
Beef slurry	32	16	8	4
Dairy slurry	16	16	16	8
Pig slurry	16	16	8	4
Dirty water	16	16	8	8
ADAS Pwllpeiran (clay loam grassland soil)				
Beef FYM	32	32	32	32
Dairy FYM	32	16	16	16
Pig FYM	32	32	>32*	16
Sheep FYM	32	16	>32*	8
Broiler litter	32	32	>32*	16
Beef slurry	32	32	32	16
Dairy slurry	32	32	32	16
Pig slurry	32	32	>32*	16
Dirty water	32	32	32	8

*No pathogens detected after 9 months

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