

Survival of *E. coli* O157:H7 in fecal slurry on lettuce, 2011 and 2012
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Field trials of romaine lettuce: survival of *E. coli* O157:H7 on lettuce leaves (mimic fecal transfer during irrigation)
 ARS Salinas, California, July 2011



$C_0 = \sim 6.3 \times 10^7$ *E. coli* O157:H7 in 0.5 ml rabbit fecal slurry
 Sample 0, 1, 1, 2, 3, and 4 days after irrigation
 Climate recorded and aspect of lettuce relative to the midday sun



	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96			
Beds			Sp																																		Sp		
41			4							1						1																					3		2
42									3																														0
43																																							2
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2.5 hours of overhead irrigation using Nelson rotator emitters
 1.25 to 3.85 mm applied



aspect of solar radiation and shadows

Inoculum preparation



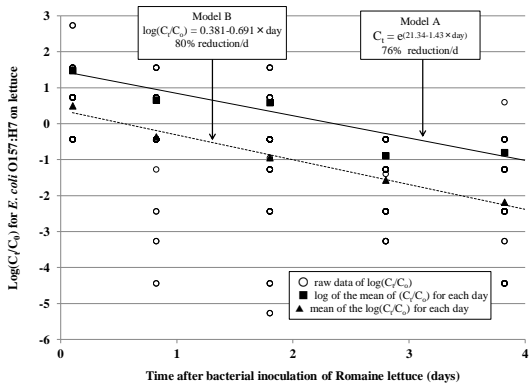
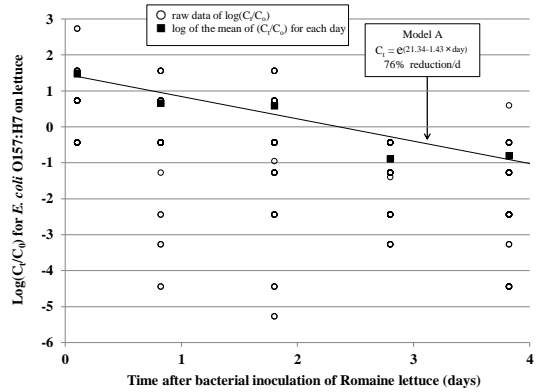
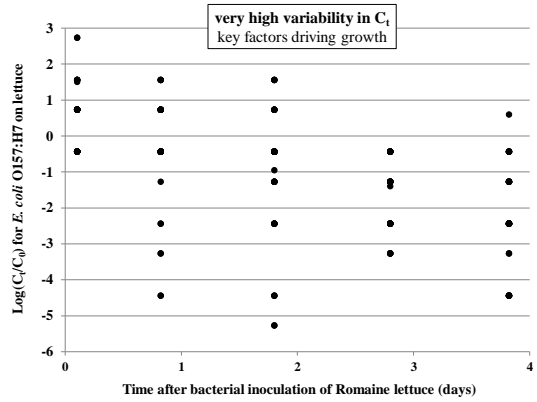
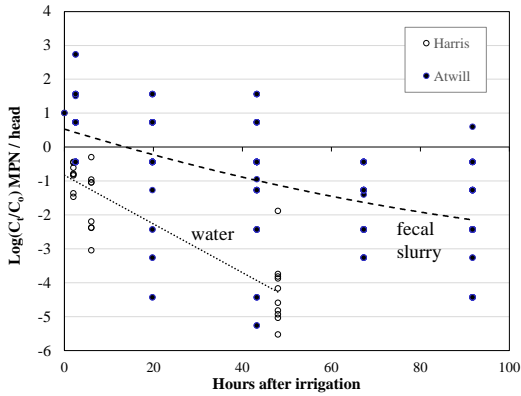
- Fecal slurry
 - 2011 1:2.2 fresh fecal : PBS-*E. coli* O157
 - 2012 1:4.0 fresh fecal : PBS-*E. coli* O157
- High concentration assay
 - Detection limits
 - 340 to 3.5×10^{12} CFU/head
 - 2×6 MPN
 - 100-fold serial dilutions
 - Channel streak onto ChromAgar O157



Field inoculation



- Fecal slurry
 - July 2011
 - Rabbit only
 - July & October 2012
 - Rabbit, pig & chicken
 - Inoculated 0.5ml/head
 - Outer leaf ~1/3 from edge
 - Mean 6.5 hr hold time

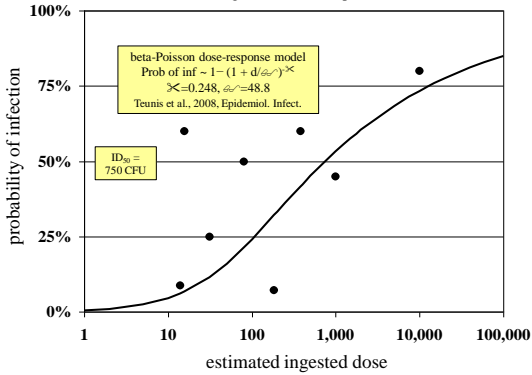


Days (h) post-inoculation	No. of samples	Mean C_t	Mean (C_t/C_0)	Log of mean (C_t/C_0)	Mean of $\log(C_t/C_0)$	Difference
0.1 (2.5)	48	1.90×10^9	30.21	1.48	0.50	-0.98
0.8 (20)	48	2.89×10^8	4.58	0.66	-0.36	-1.03
1.8 (43)	48	2.44×10^8	3.88	0.59	-0.94	-1.53
2.8 (67)	46	8.08×10^6	0.13	-0.89	-1.57	-0.68
3.8 (92)	48	9.90×10^6	0.16	-0.80	-2.18	-1.38

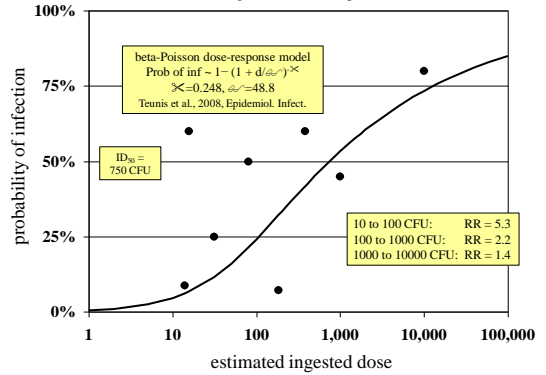
$$\log\left(\frac{\sum_{i=1}^n x_i}{n}\right) \geq \frac{\sum_{i=1}^n \log(x_i)}{n}$$

$$\log(E(Y|X)) = \alpha + \beta X \geq E(\log(Y|X)) = \alpha + \beta X$$

Estimated dose-response curve for foodborne *E. coli* O157:H7:
what does a log difference in exposure mean?



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what does a log difference in exposure mean?



2012 Trials, Salinas CA

$C_0 = \sim 5 \times 10^7$ *E. coli* O157:H7 in 0.5 ml rabbit, pig, chicken fecal slurry.
Sample daily for 10 days, starting immediately after irrigation (Aug 1 and Oct 21),
with second irrigation at day 5.



	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96			
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**Climatic conditions during field trials
Salinas, CA**

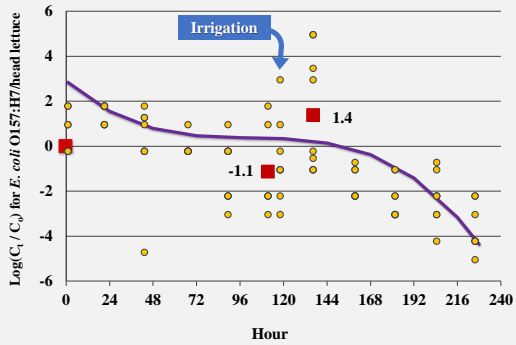
Trial		Air Temp (°C)	Soil Temp (°C)	Solar Rad (W/sq.m)	Wind Speed (m/s)	Humidity (%)	Vapor Pressure (kPa)	Dew Point (°C)
July 2011	Min	8.2	18.2	0	0.7	67	0.9	5.5
	Ave	12.2	19	242	2.6	82	1	8.9
	Max	16.4	20	945	5.3	100	1.4	12.5
July 2012	Min	10.7	19.8	0	0.9	74	1.4	10.7
	Ave	13.4	20.9	201	2.8	94	1.7	12.3
	Max	17.8	21.7	939	5.2	100	2.2	14.7
Oct 2012	Min	5.9	11.9	0	0.9	18	0.7	2.7
	Ave	14.5	16.7	142	3	80	1.3	16.6
	Max	29.3	17.8	679	7.6	100	2	17.5

***E. coli* O157 survival in fecal slurry on Romaine lettuce
Salinas, CA 2012**

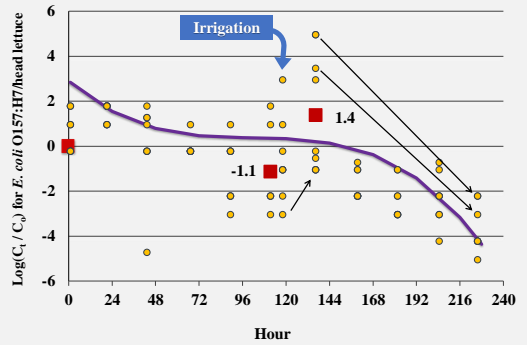
	% pos. (n=572)	applied MPN/Head	0.1 day MPN/head	6 day MPN/head	10 day MPN/head	log(C ₁₀ /C ₀)	log(C ₁₀ /C _{max})
July 27-Aug 6, irrigate Aug 1, 1.25-3.85 mm							
Pig	100% (96)	3.78×10^7	7.68×10^8	7.94×10^{11}	6.30×10^4	-2.78	-7.74 ^b
Rabbit	100% (95)	3.76×10^7	7.12×10^8	4.30×10^{10}	7.52×10^4	-2.70	-6.49
Chicken	100% (96)	4.17×10^7	1.60×10^8	4.38×10^{11}	1.53×10^5	-2.44	-7.36 ^b
Oct 16-Oct 26, irrigate Oct 21, 1.25-2.15 mm							
Pig	100% (94)	4.56×10^7	1.03×10^8	8.93×10^9	1.53×10^5	-3.56	-6.76
Rabbit	100% (96)	5.00×10^7	6.72×10^8	4.36×10^8	4.27×10^4	-3.07	-4.73
Chicken	100% (95)	3.03×10^7	4.95×10^8	1.01×10^8	1.82×10^4	-3.22	-5.10

^a Subset of Samples positive by enrichment only, excluded from regression analysis
^b Estimated value exceed MPN limit of detection

Negative binomial regression of *E. coli* O157 survival in pig fecal slurry, Salinas, CA, July, 2012



Negative binomial regression of *E. coli* O157 survival in pig fecal slurry, Salinas, CA, July, 2012



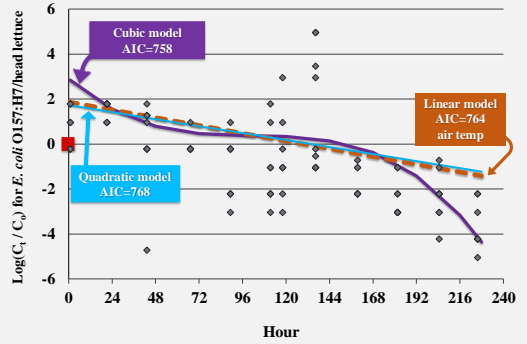
Negative Binomial Model July 2012



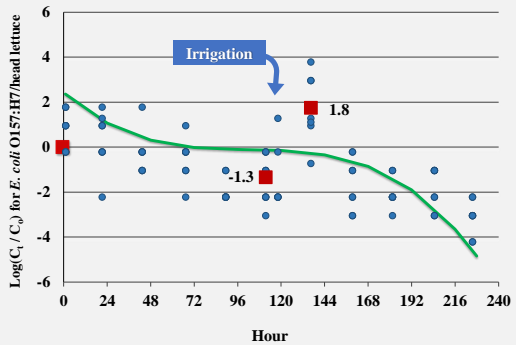
Variable	Coef.	P-value	95% CI	
<i>Fecal</i>				
Pig ^a	0			
Rabbit	-1.12	0.001	-1.79	-0.44
Chicken	-1.00	0.005	-1.69	-0.31
Hour	-0.17	0.000	-0.26	-0.08
Hour ²	0.002	0.003	0.00	0.00
Hour ³	-5.24E-06	0.004	0.00	0.00
Solar Radiation ^b	-0.005	0.001	-0.01	0.00
Intercept	7.96	0.000	5.30	10.63

^a Referent category
^b Average solar radiation 24 hours prior to harvest

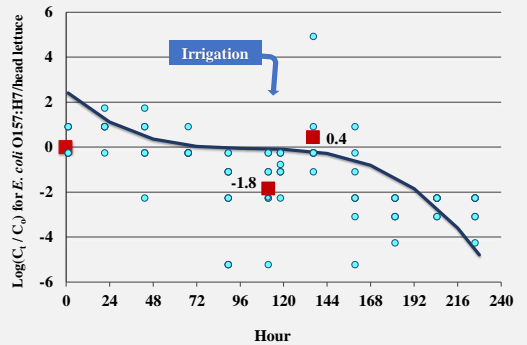
Comparison of models fits of *E. coli* O157 survival for pig fecal slurry, Salinas, CA, July, 2012



Negative binomial regression of *E. coli* O157 survival in rabbit fecal slurry, Salinas, CA, July, 2012



Negative binomial regression of *E. coli* O157 survival in chicken fecal slurry, Salinas, CA, July, 2012



Negative Binomial Model October 2012

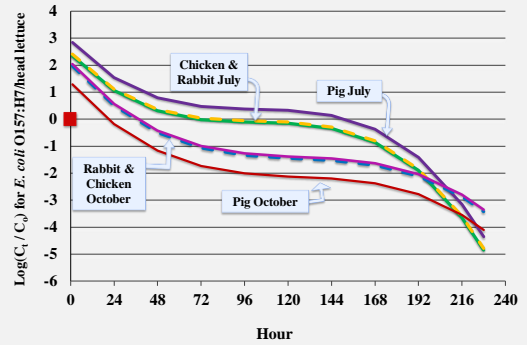


Variable	Coef.	P-value	95% CI	
Fecal				
Pig ^a	0			
Rabbit	1.74	0.000	0.83	2.64
Chicken	1.58	0.001	0.66	2.50
Hour	-0.18	0.000	-0.26	-0.10
Hour ²	0.0014	0.014	0.0003	0.0024
Hour ³	-3.56E-06	0.072	-7.44E-06	3.24E-07
Wind Speed ^b	-1.64	0.002	-2.69	-0.59
Intercept	7.73	0.000	3.56	11.91

^a Referent category

^b Average wind speed 24 hours prior to harvest

Negative binomial regression of attenuated *E. coli* O157:H7 survival in fecal splash during two 2012 field trials

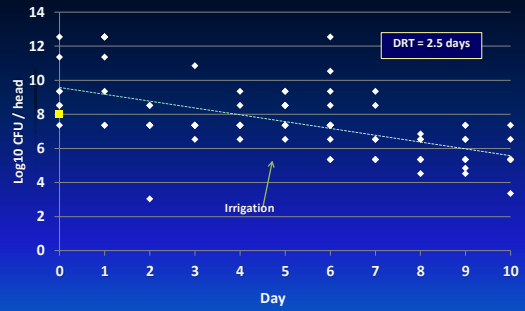


Thanks to a hard working crew!



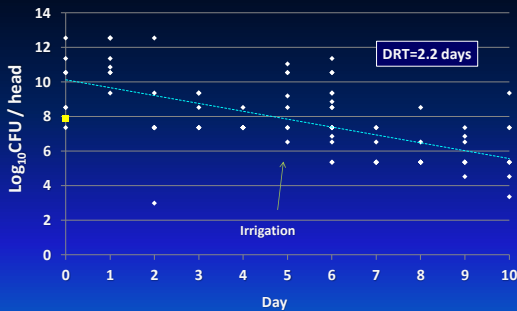
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Rabbit: indicator *E. coli* Rif^r on Romaine lettuce leaves



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Chicken: indicator *E. coli* Rif^r on Romaine lettuce leaves



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