

Food safety in fresh produce: Partnering with industry for success

Robyn McConchie
Faculty of Agriculture and Environment
University of Sydney

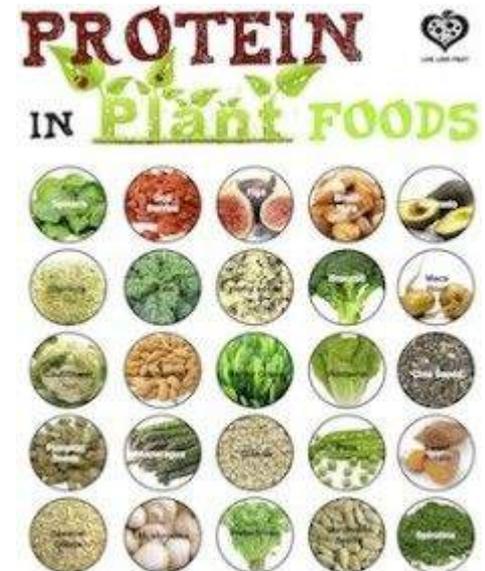




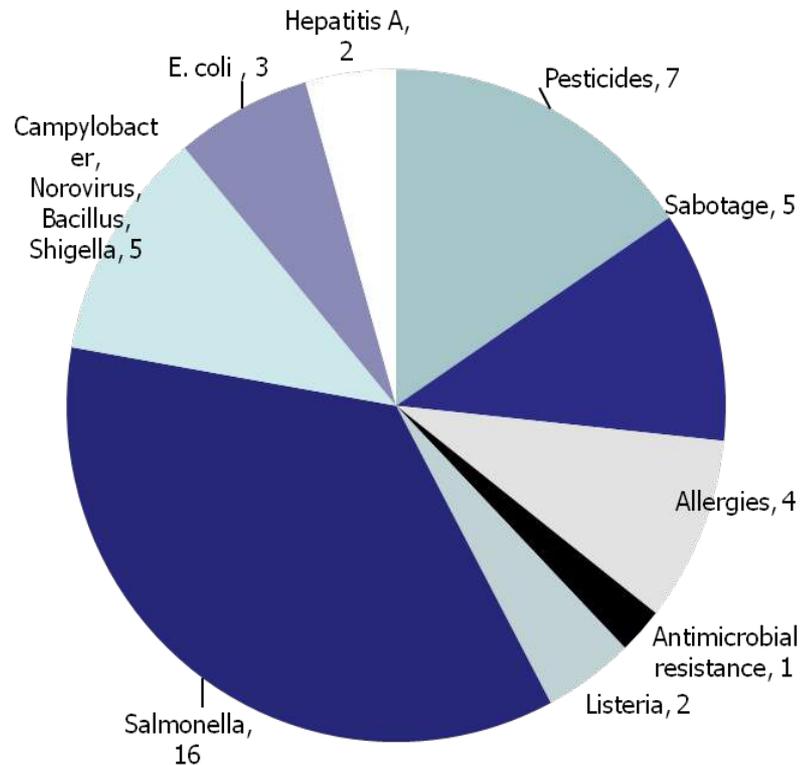
- Fresh produce is important part of healthy diet
- In Australia only 6% eat enough vegetables – 5 serves per day
- Increased consumption, larger scale production and more efficient distribution of fresh produce
- Increase in the number of illness outbreaks
- Produce eaten raw e.g. leafy greens and fruit are vehicles for transmission of human pathogens
- Bacterial pathogens major contributors

What are the risks with plant based foods?

- **Microbial** – raw fruit and vegetables, unpasteurised juices, fresh cuts e.g. *Salmonella*, *Campylobacter*, *Listeria*, Shiga-toxin–producing *E. coli*
- **Pesticide** contamination
- **Mycotoxins** e.g. aflatoxins, fumonisin, alternariol, patulin, ochratoxin
- **Allergens** e.g. peanuts, gluten, plant defence compounds



Recalls and reported illnesses from horticultural produce in Australia



Source: Richard Bennett 2014 PMA Technical Manager

- An unofficial listing of **recalls and reported illnesses** over 10 years in Horticultural produce (n=45)
- Microbial contamination the most prevalent category
- Salmonella the most prevalent cause of illness
- Fruit and veg equally represented
- Nuts also prominent, particularly almonds
- Residues not as significant as expected

Hepatitis A outbreak linked to frozen berries imported to Australia 2015

- In early 2015, 33 cases of Hepatitis A were linked to consumption of Nanna's frozen berries
- One consumer packet and a retail packet tested positive but no other positive tests returned
- Company also recalled Creative Gourmet brand as packaged in same facility
- Pressure on Govt for better country of origin labelling



Mung bean sprouts Australia 2016

- More than 230 cases of *Salmonella* Saintpaul in SA since December 2015
- More than 120 this past year, 43 in hospital
- Seeds from QLD, grown in factories in SA and packaged
- Not sure where the contamination is happening



<http://www.skynews.com.au/news/national/sa/2016/04/22/qld-bean-sprouts-cause-sa-salmonella-cases.html>

Packaged lettuce Australia 2016

- Salmonella contamination of packaged salad greens
- Affected more than 140 people
- Source: Tripod farms Vic
- Distribution: Coles, Woolworths, Lite n Easy, 7 eleven
- Possible link to fertiliser from chickens

<http://www.smh.com.au/business/retail/lettuce-salmonella-cases-reach-143-as-tripod-farmers-continues-investigation-20160211-gmrufa.html>



Salmonella on Rockmelons in August 2016



- 80 cases
- Single producer in the Northern Territory
- Rockmelon industry has been devastated by Cucumber Green Mottle Mosaic Virus (CGMMV)
- Too quick to get back into production?
- Previous problems in 2006 – a high risk crop

<http://www.abc.net.au/news/2016-08-03/rockmelon-salmonella-warning/7684364>

Fresh Produce Safety Centre



FRESH PRODUCE
SAFETY CENTRE

AUSTRALIA & NEW ZEALAND



PROUDLY HOSTED BY

THE UNIVERSITY OF
SYDNEY

PROGRAM PARTNER



FPSC Objectives

Research

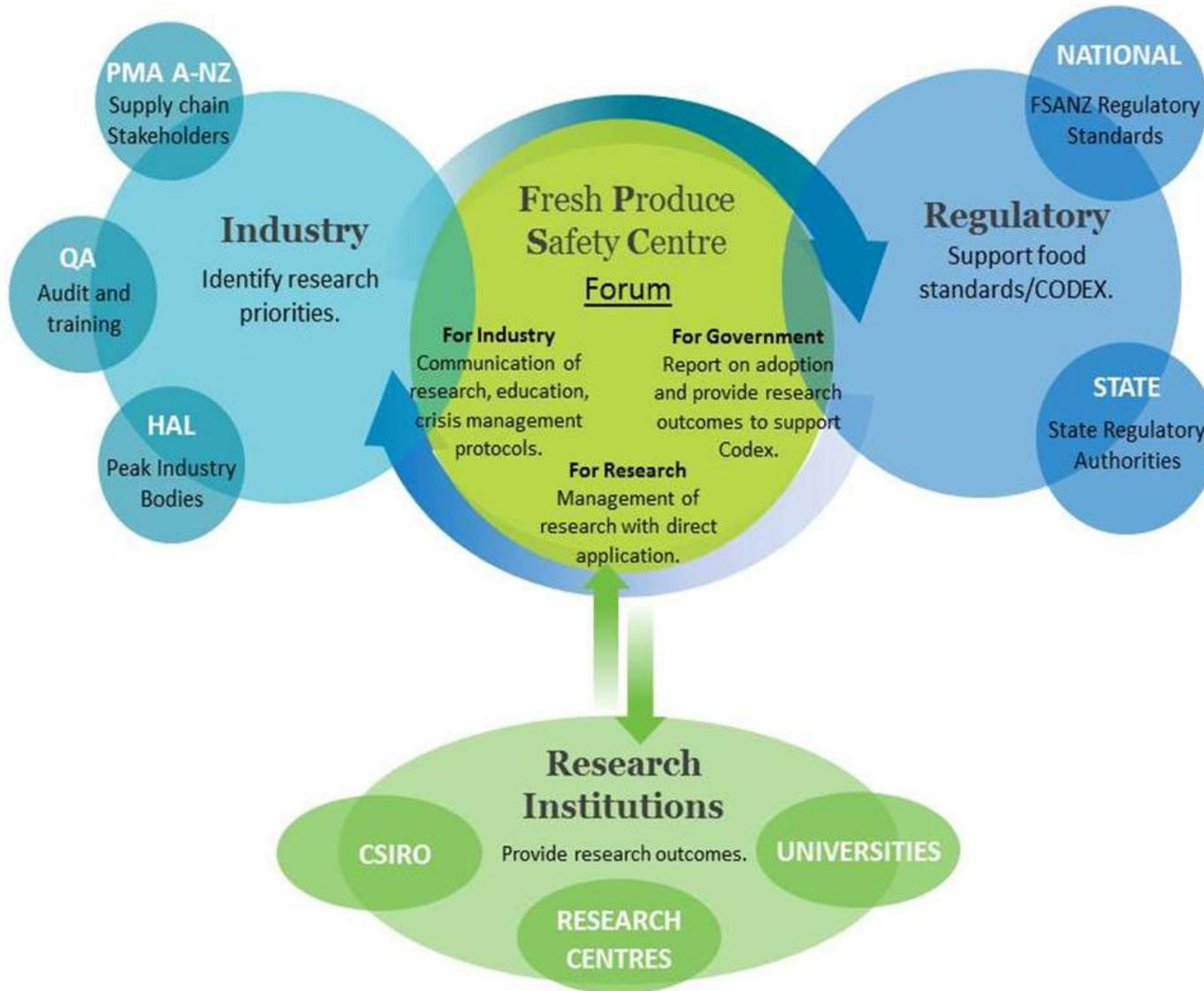
- Identify priorities for research into food safety
- Commission & manage research projects

Outreach

- Increase awareness, provide information, e-newsletters, workshops
- Forums and conferences

Consultation

- Across all sectors of fresh produce supply chain
- Regulatory authorities
- International organisations (e.g. Center for Produce Safety)
- Crisis management coordination

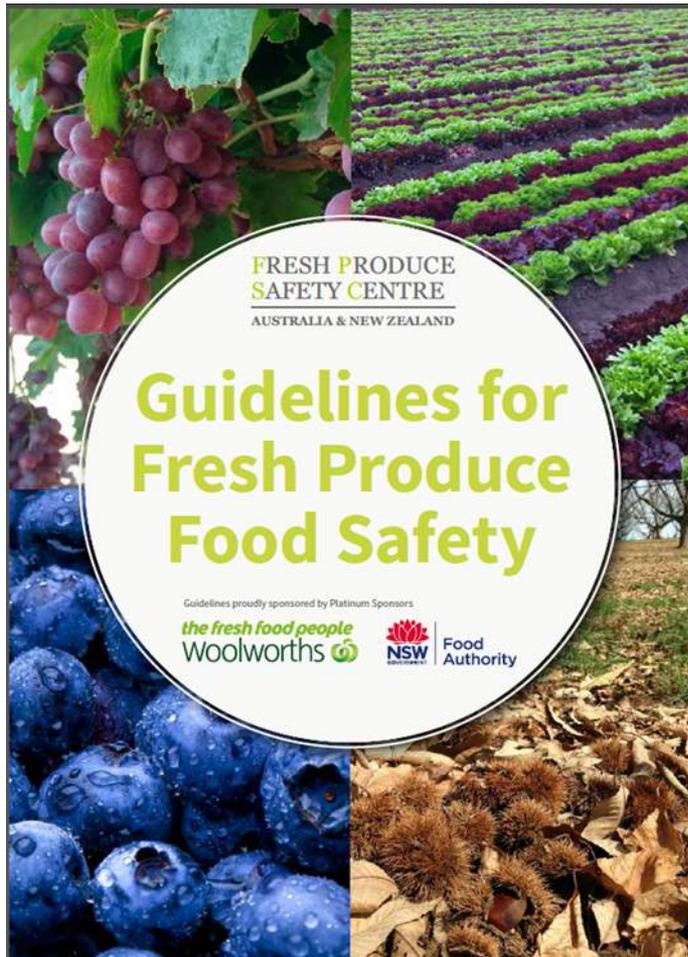


<http://freshproducesafety-anz.com/>

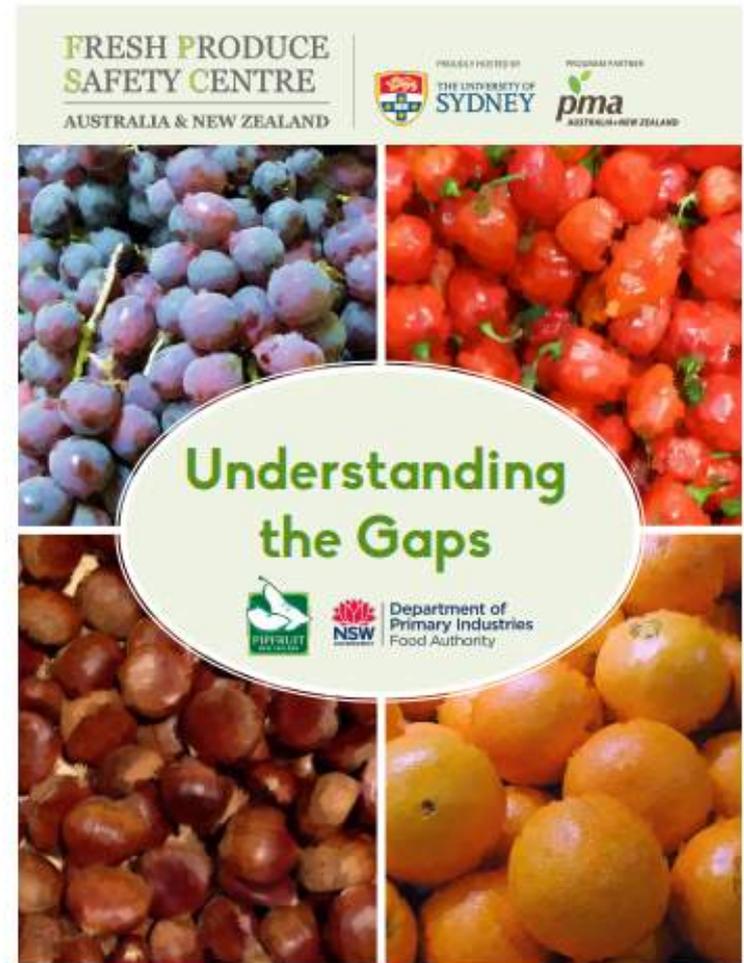
Totally Funded by Industry



FPSC Commissioned Projects Released in 2015



<https://freshproducesafety-anz.com/guidelines>



<https://freshproducesafety-anz.com/understanding/>

Safe Use of Manures Requires Composting

- At the end of the process compost should achieve
 - *E. coli* < 100cfu/g
 - *Salmonella* Not detected in 25g
 - Verified through testing

StandardMark Certified Compost Scheme

AS 4454 Composts, soil conditioners and mulches



How does *Salmonella* Contaminate Fresh Produce



- Soil amendments with chicken manure has benefits (N-P-K, physical properties), but associated with *Salmonella*
- Pre-harvest contamination of vegetables is mainly from the use of fresh/improperly composted manure
- Australia - most salad producers do not use manure amendments because of the risk
- *Salmonella* also common in water
- Usually test for nonpathogenic *E. coli* and indicator of faecal contamination

Proximity to Vegetable Production



Proximity to Irrigation Source



Organic Farming - Composting central to production



Salmonella survival under Australian field conditions?



- If chicken manure added how long would *Salmonella* survive under field conditions?
- Current recommendations based on Huber A. *et al.* 2011. Pathogen die-off rates following manure application under Ontario field conditions
- 1-3 log reduction in *E. coli* O157 and *Listeria* in 3-4 weeks
- Could remediation strategies promote die-off such as cover crops and/or solarisation?

Laboratory Study: Soil Type, Temperature, \pm Manure



Inoculate with *Salmonella*



Incubate



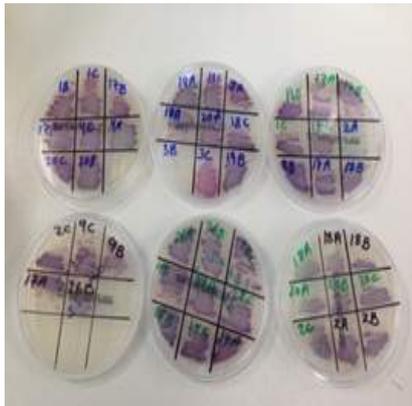
Extract



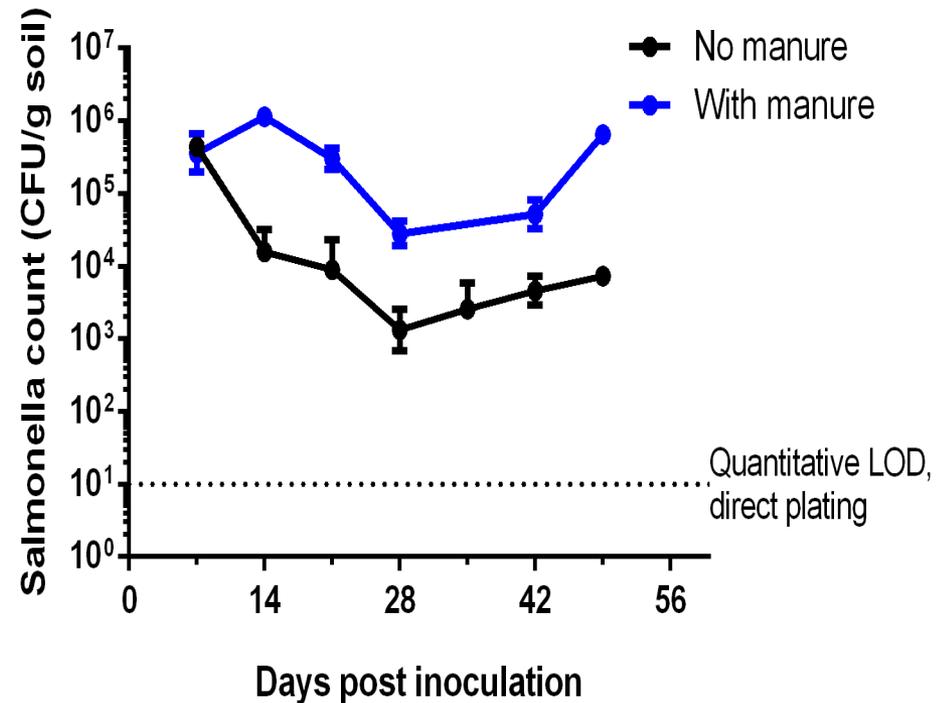
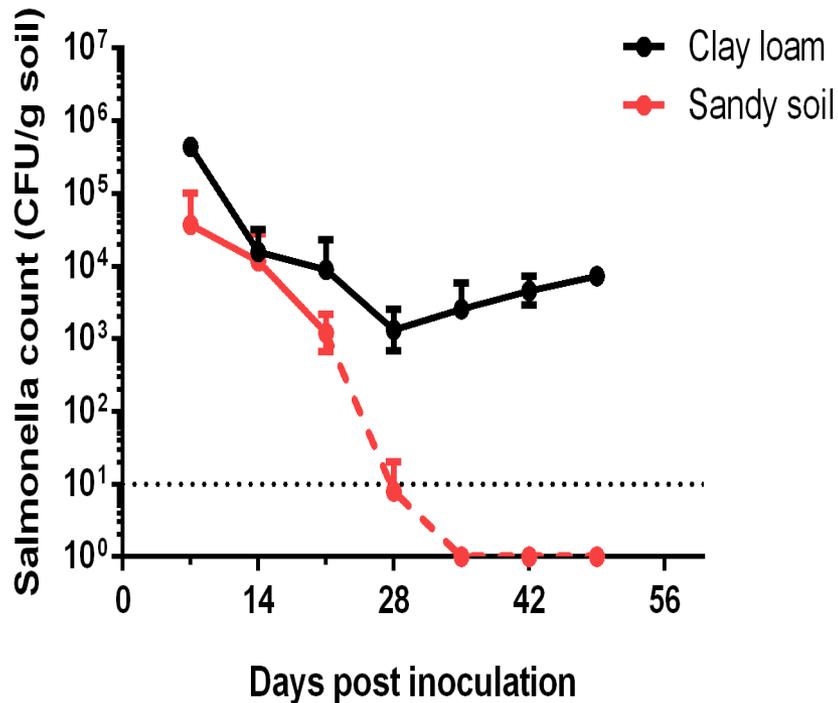
Enumerate



Enrichment



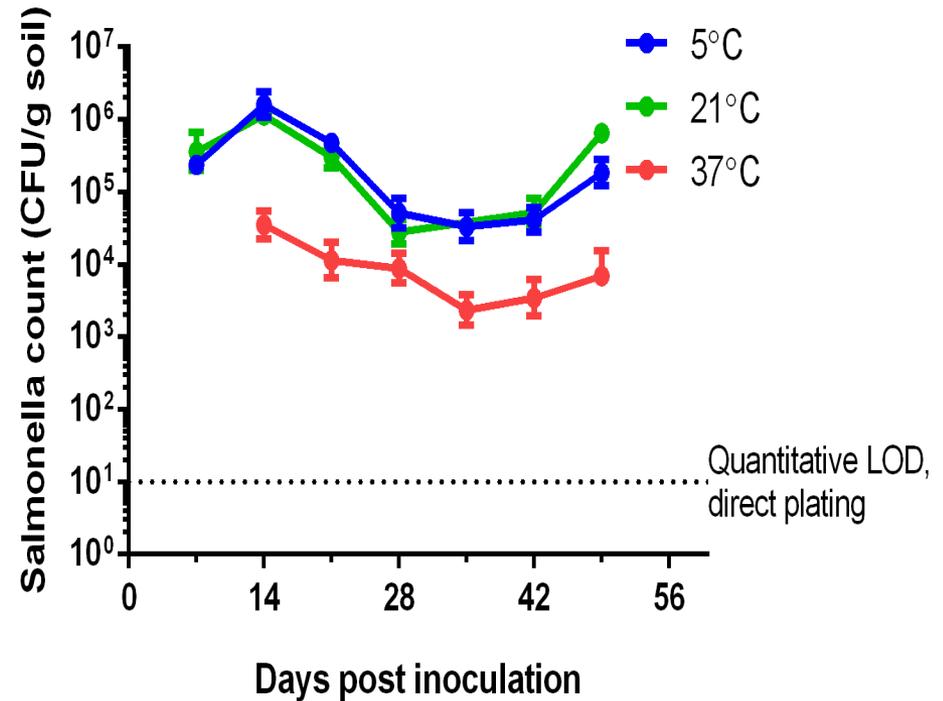
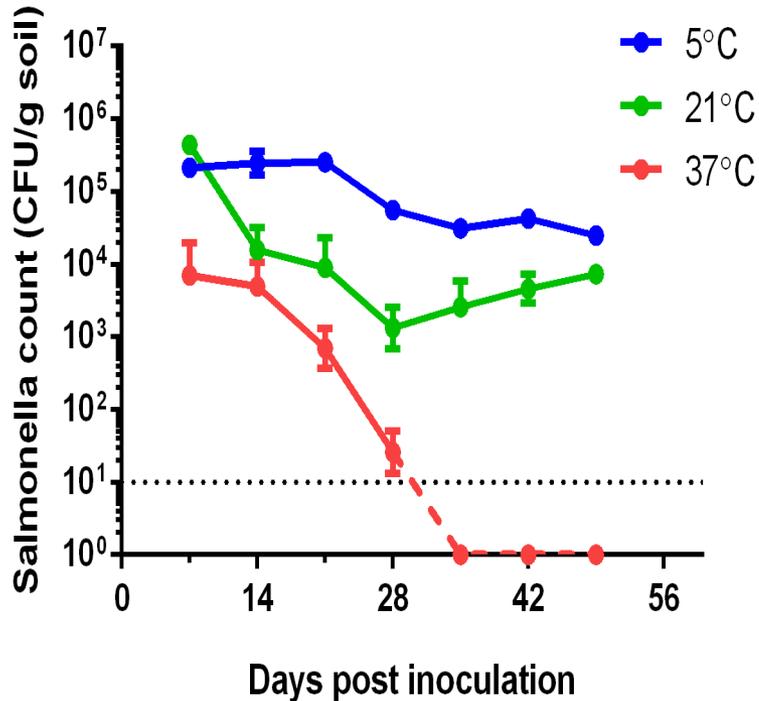
Laboratory Study: *Salmonella* Cocktail Recovery over Time



Clay loam promotes survival of *Salmonella* compared to sandy soil

Presence of manure promotes *Salmonella* survival

Laboratory Study: Salmonella Cocktail Recovery-Temperature



High temperature (37°C) reduces *Salmonella* survival in 4 weeks

Effect of high temperature negated by addition of manure

Field Trial: Contaminate – Lettuce Crop – Cover Crop ± Solarisation



Inoculate Manure



Manure Application



Plant Lettuce



Turn in Lettuce



Solarisation

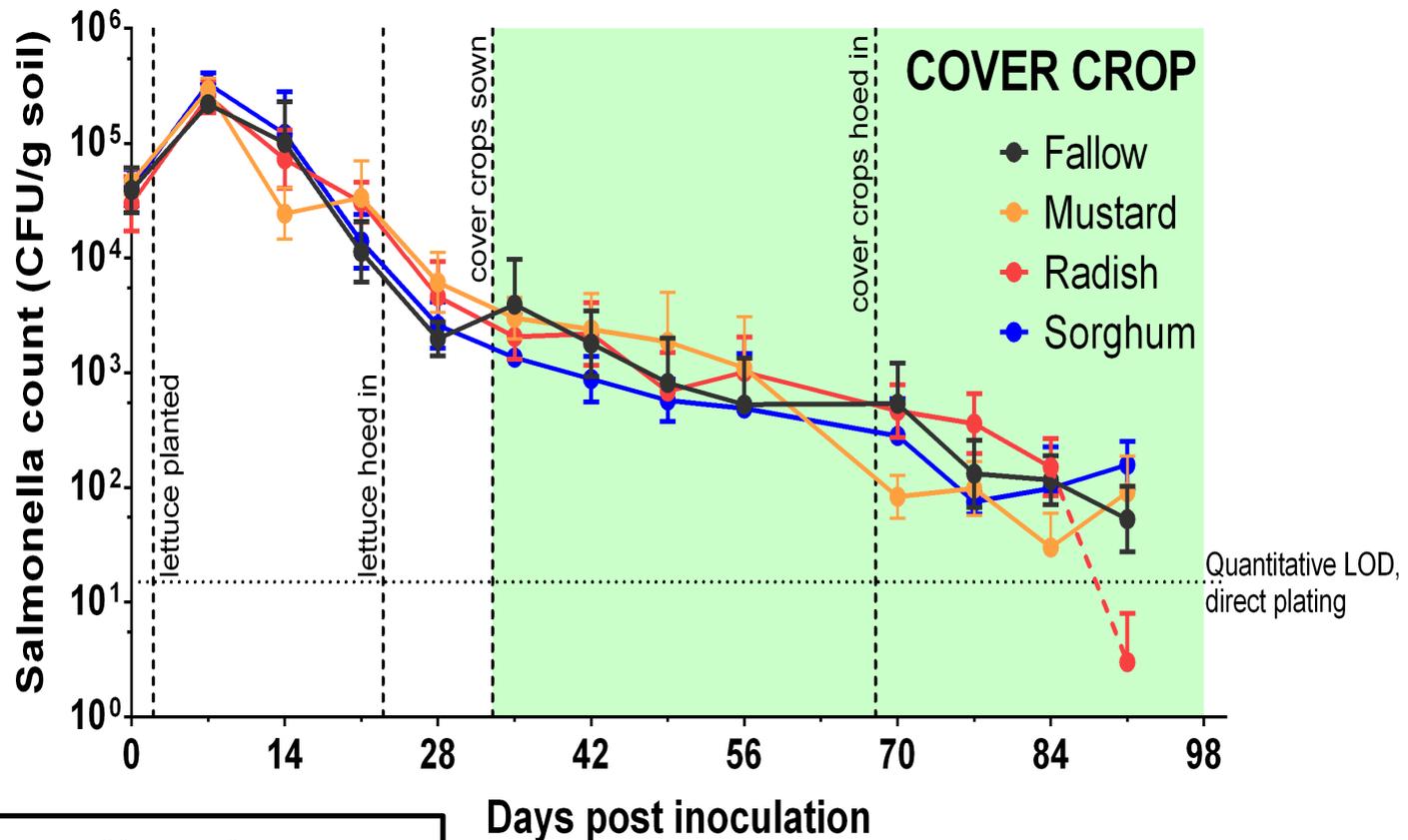


Turn in Cover Crops



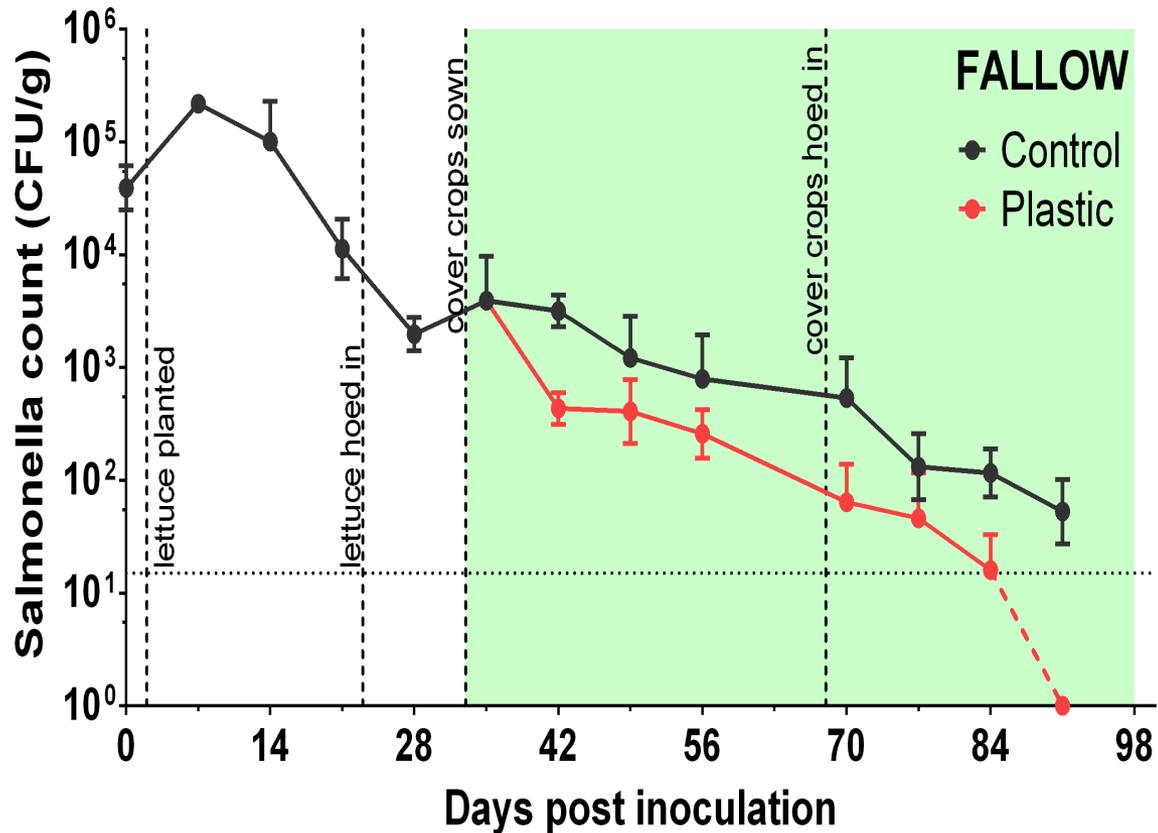
Cover Crops

Field Trial: Effect of Cover Crop



No significant effect of cover crop on *Salmonella* survival in clay loam

Field Trial: Effect of Solarisation

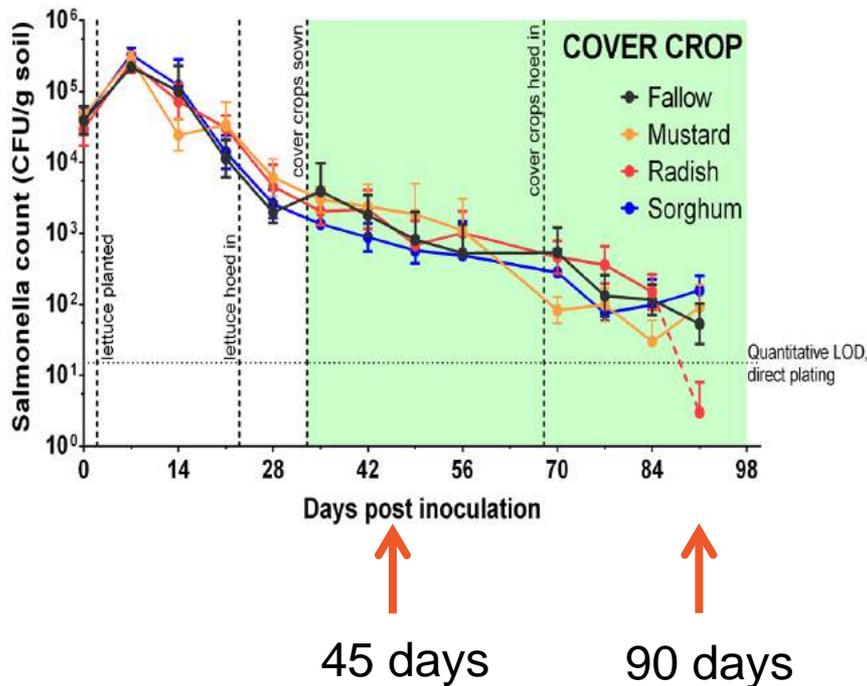


Reduced survival of *Salmonella* under solarisation in clay loam

What does this study tell us?

- **Sandy soil** *Salmonella* dies off to a level below detection limit after 21 days
- **Clay loam** Survival of *Salmonella* is enhanced
- **High temperature** $> 37^{\circ}\text{C}$ caused die-off of *Salmonella* in 28 days
- **Manure** Promoted survival in sandy soils and high temperatures
- **Solarisation** Hastened *Salmonella* die-off in field trials to zero detection after 49 days

Does this tie in with safety guidelines?



- Harvest must be after **45** days for low risk or **90** days for high risk products must pass between application and harvest.
- Based on research in Canada where they saw a 1-3 log reduction in the first 3 to 4 weeks following application for *E.coli*, *Salmonella*, *E.coli* O157 and *Listeria*
- Our Australian *Salmonella* data also saw a 1-3 log reduction in 45 days but persisted for 90 days (unrealistic starting count?)
- No regulations concerning counts in soil – only compost

ARC Industrial Transformation Research Program

Unique Opportunity: Collaboration between Industry and Researchers

Two schemes:

- Industrial Transformation Research Hubs
- Industrial Transformation Training Centres
- To foster close partnerships between university-based researchers and industry to **provide innovative training for early career researchers** vital to Australia's future industry.
- Selection Criteria updated 2016:
 - Will the Centre drive growth, productivity and competitiveness within key growth sectors?
 - Is there a clearly identified market opportunity and benefit to Australian industry?



Australian Government

Australian Research Council



FRESH PRODUCE SAFETY CENTRE

AUSTRALIA & NEW ZEALAND

2017-2020



THE UNIVERSITY OF SYDNEY

Program partner



The University of Sydney



GSF FRESH AUSTRALIA PTY LIMITED



Three Project Themes – Nine Projects

On-Farm Environment



9 PhD Students
3 Postdocs
21 Industry Partners

Postharvest Environment



Risk Assessment



Acknowledgements

Dr Trevor Suslow UC Davis

Dr Kim-Yen Phan-Thien Usyd

A/Prof Tina Bell Usyd

Ms Mulatua Metafiera PhD

Ms Tatjana Matic Usyd

Mr Monty Oldroyd Usyd

- Funded by Horticulture Innovation Australia Limited with co-investment from the University of Sydney and HIA funds sourced from the Vegetable Industry Levy and the Australian Government and the Centre for Produce Safety

Horticulture
Innovation
Australia

CPS **CENTER** *for* **PRODUCE SAFETY**

Thank you



Three Project Themes – Nine Projects

On-Farm Environment

1. Microbial and protozoan contamination in composts and organic amendments
2. Microbial and protozoan parasites in water sources
3. Predictive modelling of high risk conditions
4. Preharvest applications of Electrolysed oxidising water (ewater) and other chemical interventions



Three Project Themes – Nine Projects

Postharvest Environment

5. Interactions between fungicides and sanitisers to control postharvest contamination by moulds
6. Pathogen management in storage and transport facilities



Risk Assessment

7. Indicator organisms and rapid diagnostic tests for foodborne pathogens
8. Risk assessment in apples
9. Risk assessment in leafy greens

