

Overview of Fresh Produce Supply-Chain Food Safety Management

Ag in Uncertain Times Webinar

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Food Safety Must Function Across the Farm to Fork Supply-Chain



Why the Concern for Food Safety of Edible Horticultural Products?

- ❖ Overview of Food-borne Illness in U.S.
- ❖ Introduction to GAPs and Produce Outbreaks
- ❖ FSMA - FDA Produce Safety Rule
- ❖ Key On-farm Challenges
- ❖ On-farm research example



U.S. Foodborne Illness

- **CDC ESTIMATES** (Scallan et al., 2011)
 - Major foodborne pathogens (31 organisms)
 - 9.4 million cases/year (6.6 to 13 million)
 - 56,000 hospitalizations (40,000 to 76,000)
 - 1,200 deaths (710 to 2,300)
- Unspecified illness
 - 20 to 61 million cases/year
- Combined about 1 in 6 ill every year – most very mild but many severe

Food Safety Challenges

❖ Chemical

Mycotoxins

❖ Physical

❖ Biological

➤ Microbial

➤ Allergens

➤ Toxins

Chemical Hazards

- If not controlled will cause illness
 - Chemicals
 - Pesticides
 - Sanitizers
 - Lubricants
 - Fertilizers
 - Allergens
 - Undeclared ingredients
 - Cross contaminants
 - Unapproved additives
 - Mycotoxins
 - E.g., aflatoxin, ochratoxin, patulin



Chemical Hazards - Mycotoxins

- Toxins produced by fungi
 - Primarily *Aspergillus* spp., *Penicillium* spp., and *Fusarium* spp.



- Long-term chronic toxicity of concern
 - Can be carcinogenic
 - Influence immune response



Physical Hazards

- Foreign objects **capable of injuring the consumer**

- Glass
- Wood
- Stones
- Hard plastic
- Metal
- Yuck factor – animal parts



Field Sanitation includes Prevention or Mitigation of Physical Hazards

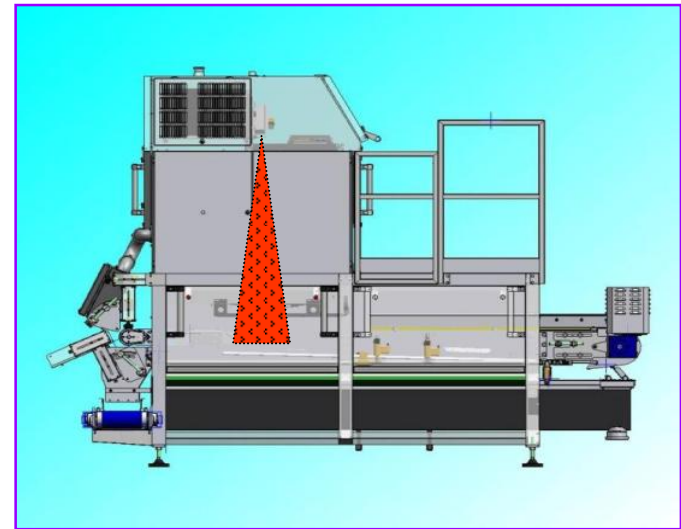


Physical hazards are most problematic in mechanized harvesting



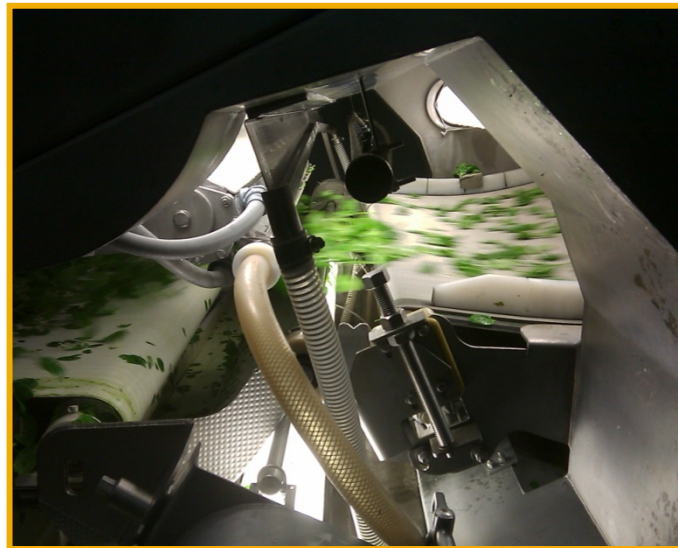


Metal Detection



Laser and X-ray Detection

**Chlorophyll-based
defect removal**



**Quality defects and physical hazards
are screened with multiple technologies and removed by air-jets**

Metallic Bandages Set Off Metal Detectors in Packaged Product



Metal Detection in Salad Plant



Finger-Bobs Cover Bandage

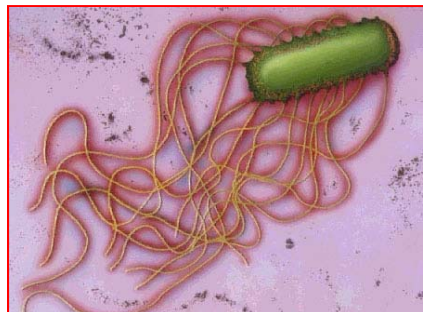
Microbial Pathogens



- ❖ Estimated 250 foodborne pathogens
- ❖ Bacteria most widely recognized
- ❖ Viruses & Parasites
- ❖ Norovirus may be > 50% of cases



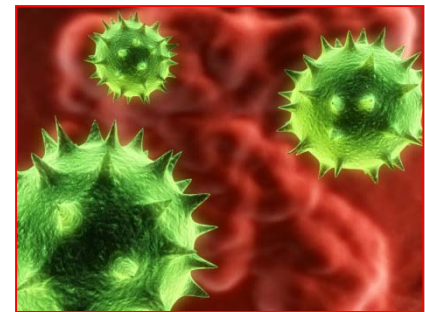
E. coli O157:H7



Salmonella

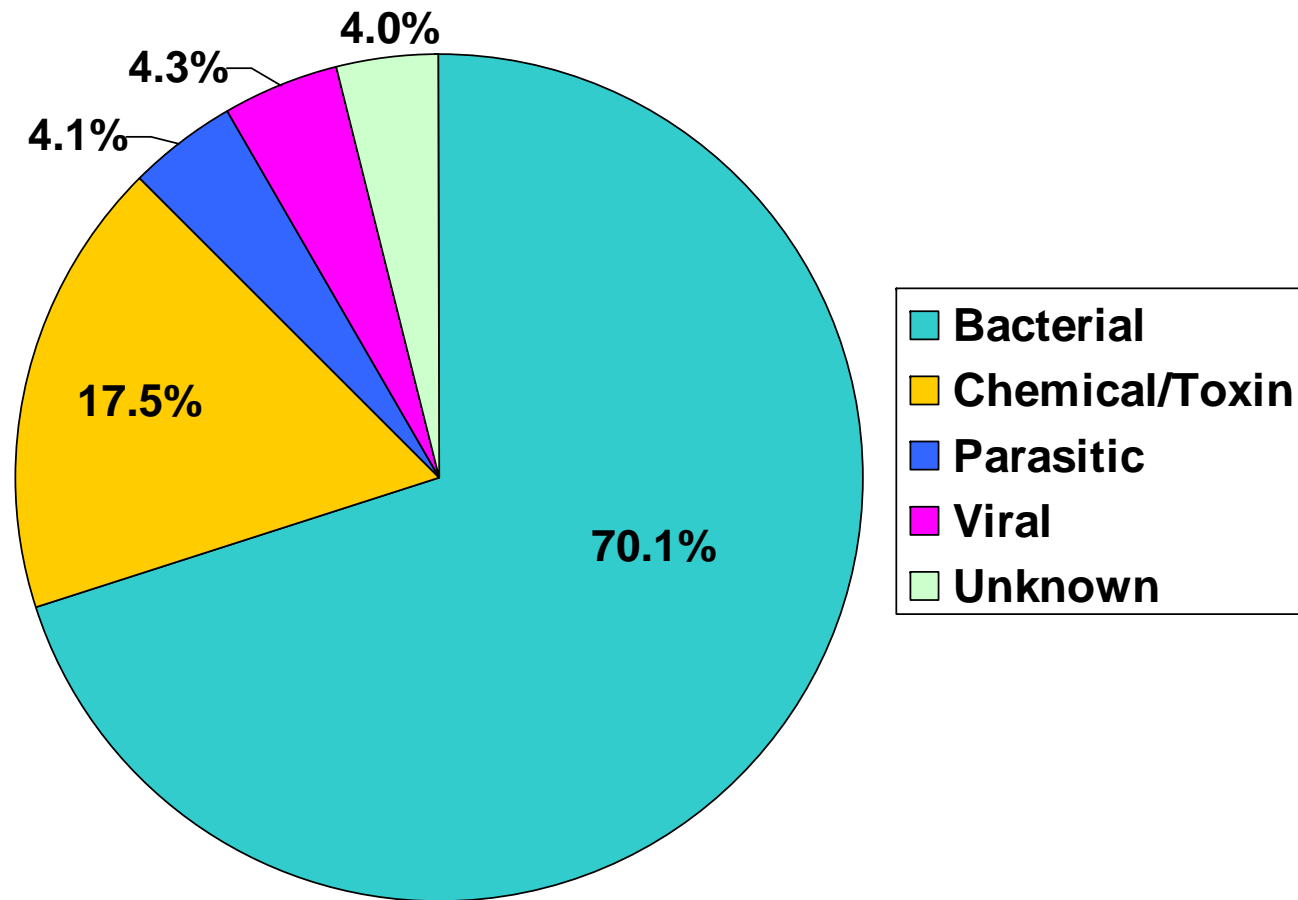


Cryptosporidium



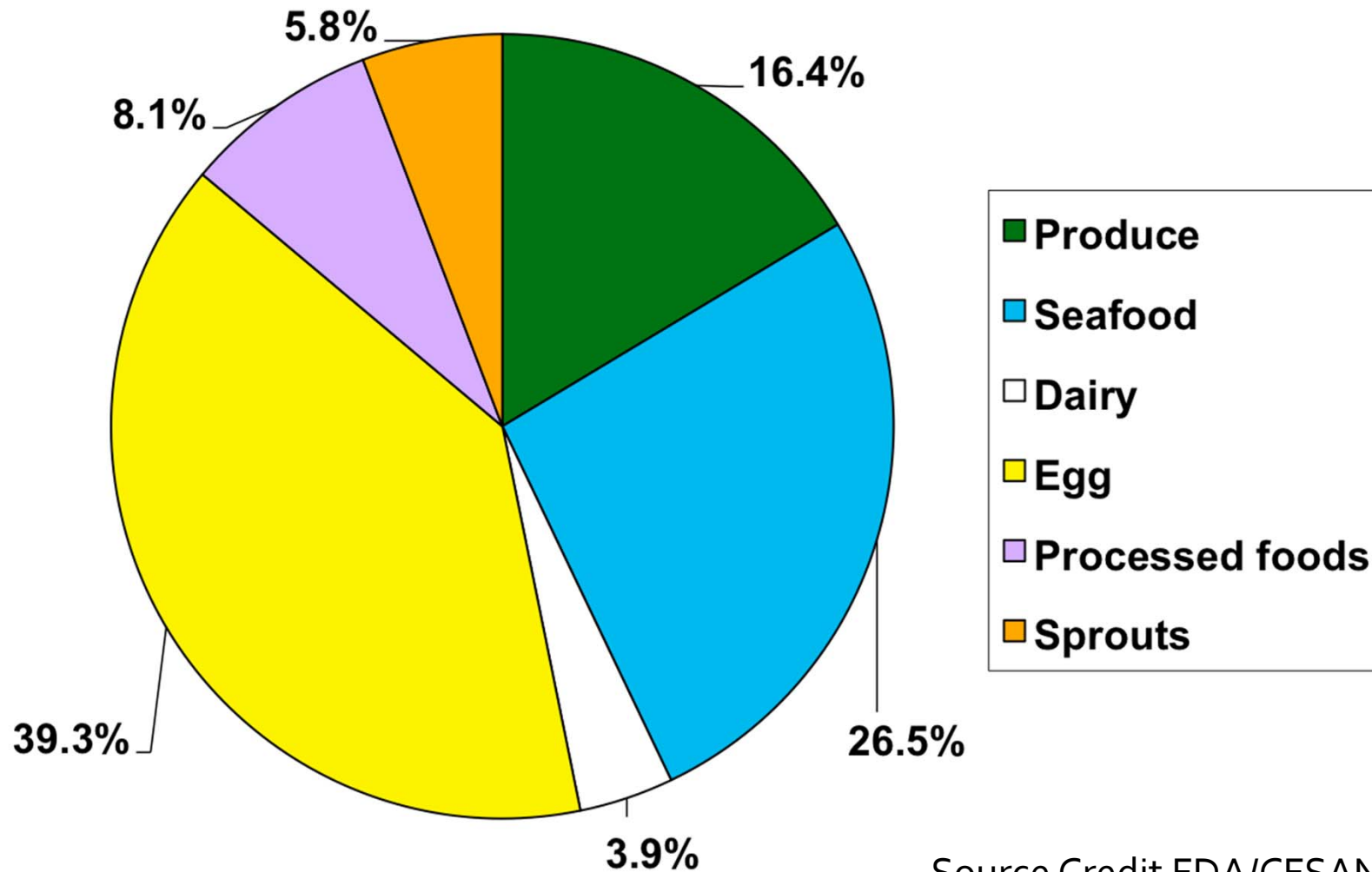
Norovirus

Reported *outbreaks* linked to FDA-regulated foods, by agent, 1996-2009 (N=532 outbreaks)



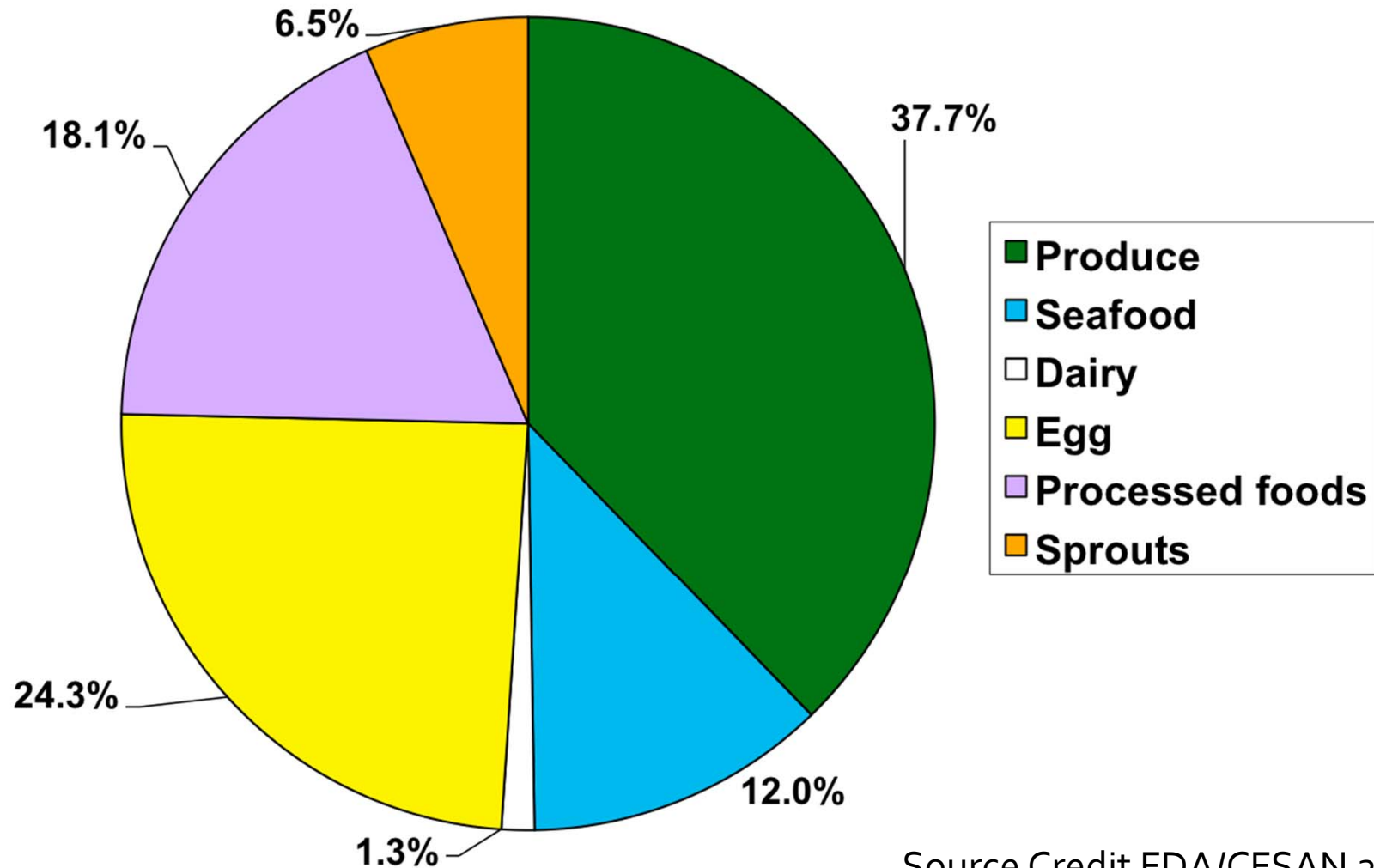
Source Credit FDA/CFSAN 2011

Reported *outbreaks* linked to FDA-regulated foods by vehicle, 1996-2009 (N=532 outbreaks)



Source Credit FDA/CFSAN 2011

Reported *illnesses* linked to FDA-regulated foods, by vehicle, 1996-2009 (N=29,750 illnesses)



Source Credit FDA/CFSSAN 2011

97 Produce Outbreaks 1999-2012

Attribution by Commodity

Lettuce/Romaine	24	Basil	4
Spinach	3	Basil or mesclun	3
Cabbage	1	Cilantro	3
Tomatoes	19	Celery	2
Cantaloupe	8	Parsley	2
Melons	3	Green onions	2
Honeydew	2	Mango	2
Squash	1	Table grapes	2
Cucumber	2	Jalapeño/Serrano	1
Raspberries	6	Snow Peas	1
Strawberries	3	Snap Peas	1
Blueberries	1	Papaya	1

Almond, Hazel, Pine Nuts, Pecan, Walnut

Sprouts

34



Good Agricultural Practices Have Focused on **Prevention** and **Redundant Reductions**

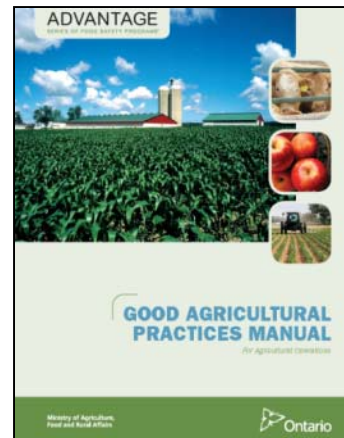
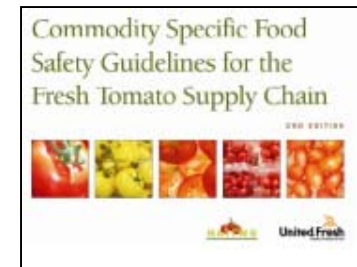
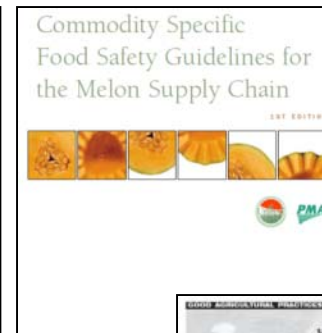
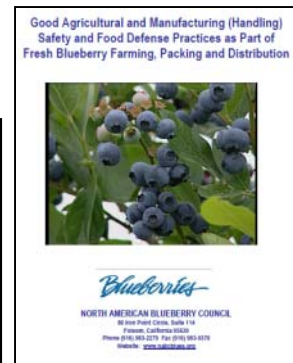
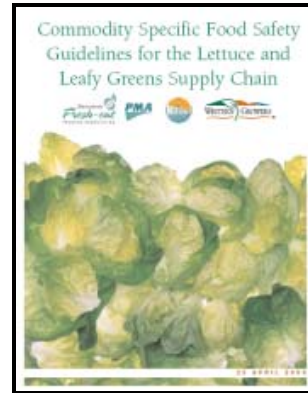
❖ FDA, 1998 guidance document

“Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables”

- ✓ Not a regulation - guidelines only
- ✓ Has been a “de facto” minimal standard
- ✓ Buyers are the enforcement branch
- ✓ Commodity-specific and Region-specific

Commodity-Specific GAPs and Food Safety Audit Checklists

- Melon
- Tomato
- Stone fruit
- Mushroom
- Lettuce & Leafy Greens
- Culinary Herbs
- Green Onions
- Sprouts
- Almond
- Citrus
- Strawberry
- Watermelon
- Blueberries
- Asparagus



Food Safety Modernization Act

Signed by President Obama January 4, 2011



It aims to ensure the U.S. food supply is safe by shifting the focus of federal regulators **from responding** to contamination **to preventing** it

Establish **science-based minimum standards** for the safe production and harvesting of those types of fruits and vegetables where it is determined that such standards minimize the risk

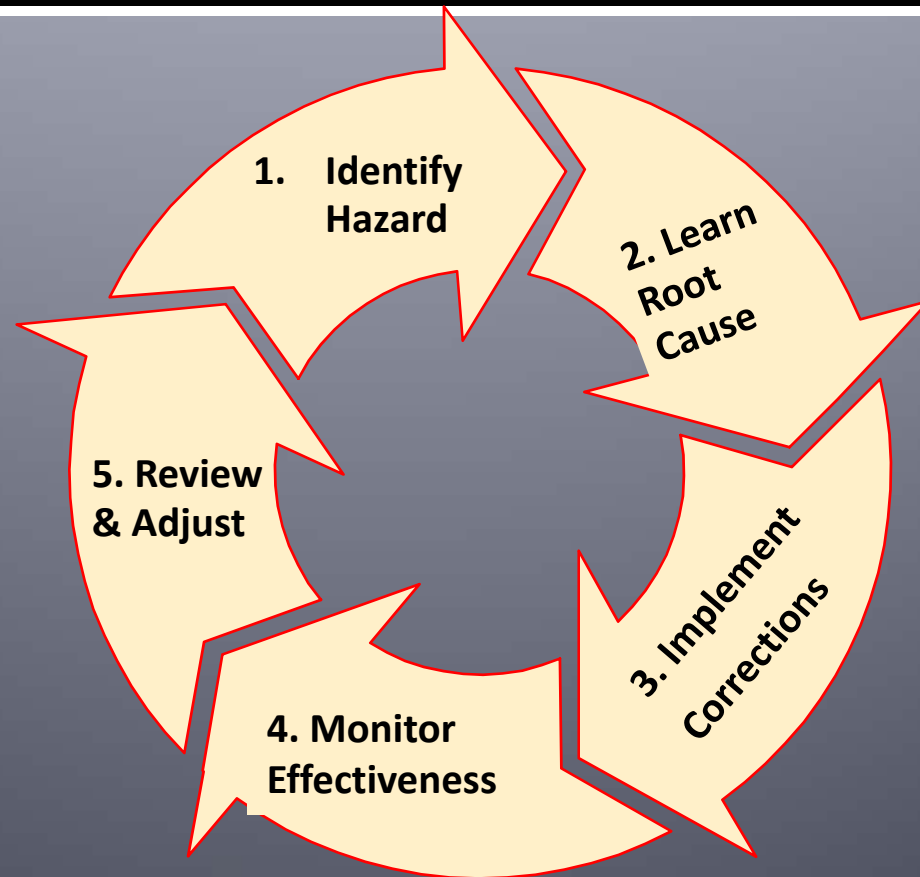
FSMA-Prevention

FDA has legislative mandate to require **science-based preventive controls** across the food supply

Mandatory preventive controls (implementation of a written preventive control plan)

- Hazard evaluation
- Preventive steps or controls to minimize or prevent the hazards
- Monitoring and verification of preventive controls
- Specify corrective actions

FDA Expectations for Working Under Preventive Controls Regulations



Food Safety Depends on Prevention Programs with Multiple Hurdles



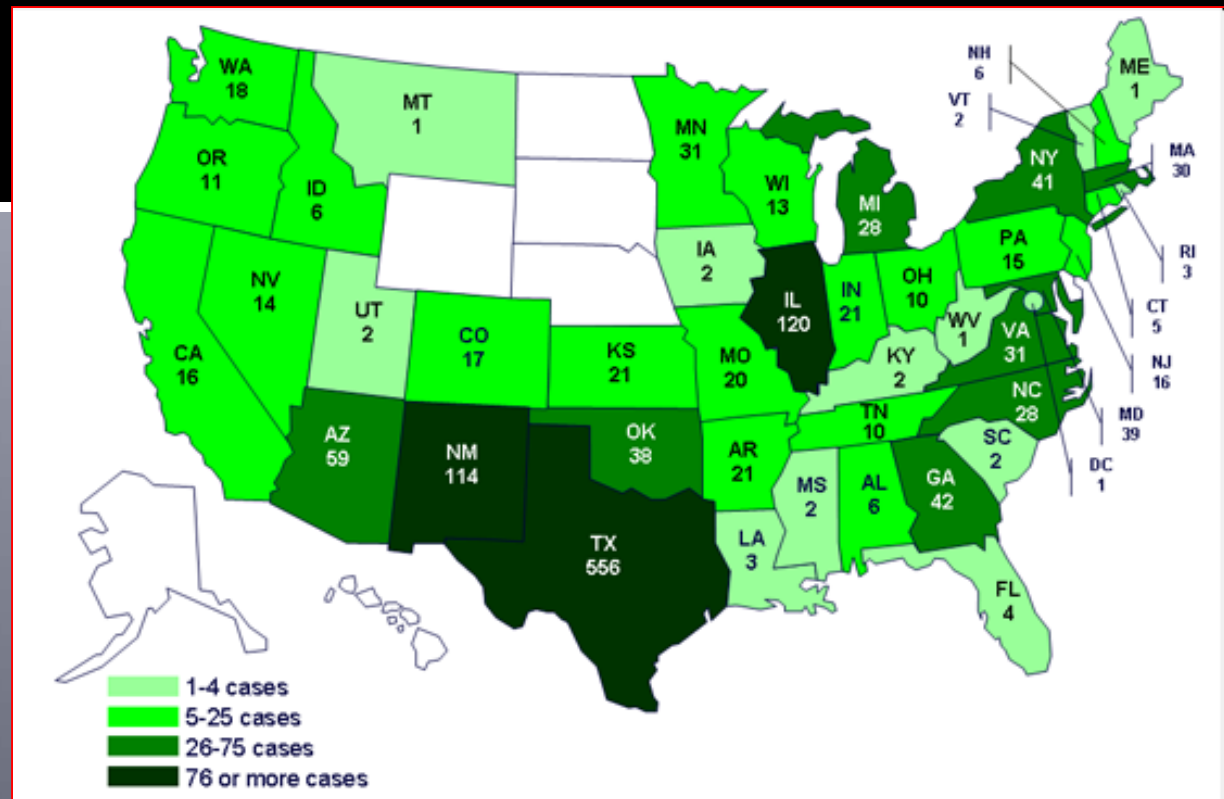
Key Areas for All Scales of Farming and Shipping

- ❖ Water –
 - Preharvest & Postharvest
- ❖ Workers –
 - Hygiene & Training
- ❖ Waste –
 - Manure & Compost
- ❖ Wildlife –
 - Intrusion & Fecal
- ❖ Record-keeping
- ❖ Traceability

There will be increasing expectations from FDA and consumer-groups for the full supply-chain to demonstrate and document the effectiveness of preventive controls and corrective actions. It is reasonable to assume the greatest pressure will be on the supply-side, from both buyers and regulators.

Aside from an elite group of the industry, most producers are ill-prepared and lack necessary scientific literacy to develop these systems without significant support.

“Small Farms” May Be Responsible for Large Multi-State Outbreaks



Cases infected with the outbreak strain of *Salmonella* Saintpaul by state, as of August 19, 2008

Exemption for Direct Farm Marketing (Sec. 105)

Farms exempt if:

- During the **last 3 years**, sales were less than **\$500,000** and
- Majority of product is **distributed directly to consumers or farmers' markets** and restaurants either intrastate or within a **275-mile radius**

Direct Marketers have Responsibilities to their Customers



Local Fresh Strawberries Tainted With *E. coli* O157:H7 Sicken 14, One Dies

- Local grown in NW Oregon
- Sold at U-pick, farm stands, farmers markets
- Consolidated berries from several farms
- Deer pellets match case isolate
- Farm investigation reveals high deer pressure



In many of the outbreak and recall investigations, there was a moment in time for someone to recognize a microbial hazard and make a prevention or control-point decision that would likely have averted or greatly reduced public risk and consequences to the industry and consumers.

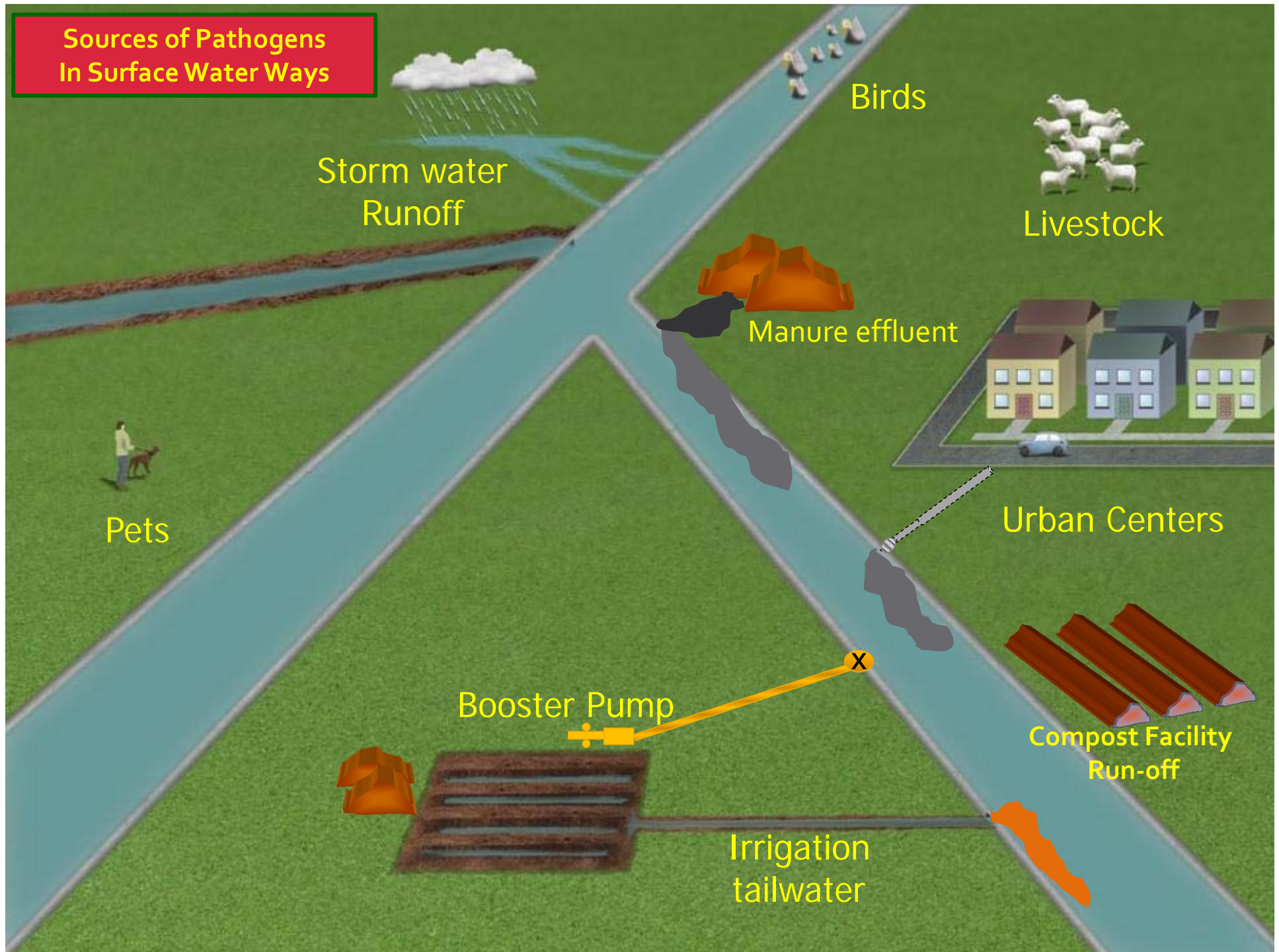
Water: The Critical Control Point?



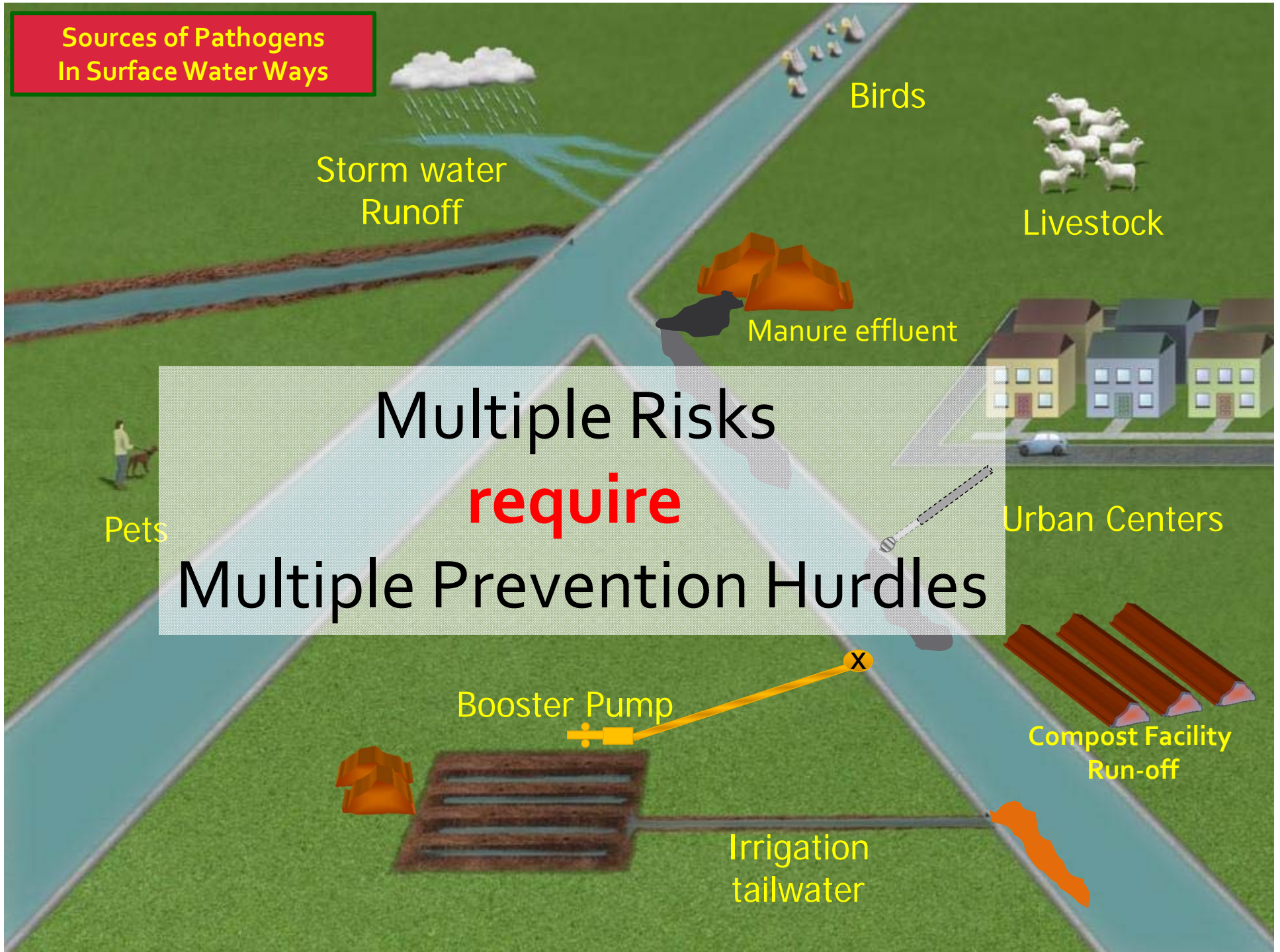
Wherever water comes into direct contact with fresh produce, its quality may directly determine the potential for pathogen contamination and its persistence.



Sources of Pathogens
In Surface Water Ways



Sources of Pathogens
In Surface Water Ways



Storm water
Runoff

Birds

Livestock

Manure effluent

Pets

Urban Centers

Multiple Risks
require
Multiple Prevention Hurdles

Booster Pump

Compost Facility
Run-off

Irrigation
tailwater

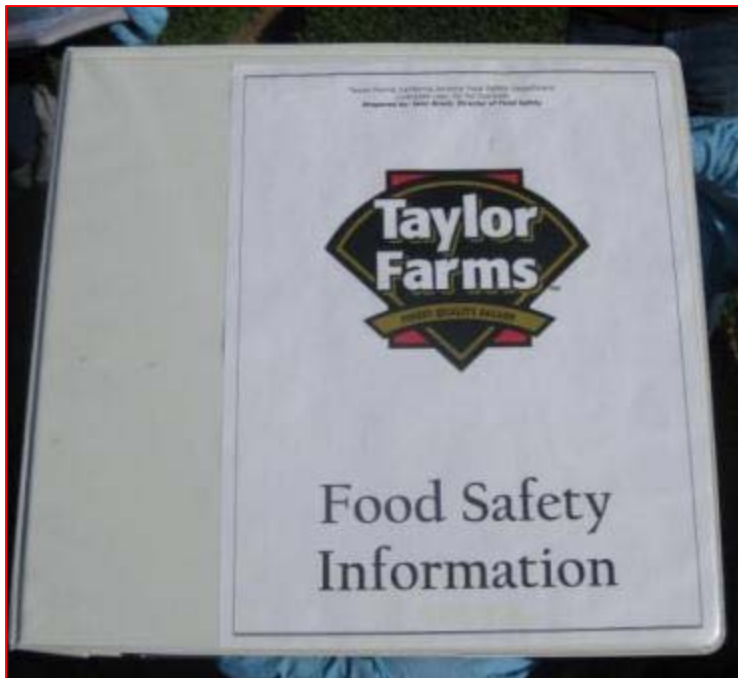
Worker Training: Field Crews, Irrigation Crews, Thinning Crews, Contract Harvest Labor, Packing, Processing



Processors Typically Have Extensive Training Materials, SOPs, SSOPs, Log Sheets, etc.



Advanced Companies Work with Harvest Contractor to Provide Standard Training and Issue Certification Cards



Compost and Soil Amendments



- ✓ Run-off to field
- ✓ Run-off to water sources
- ✓ Particulate aerosols –wind
- ✓ Particulate aerosols- spreading
- ✓ Vermin mechanical transfer
- ✓ Transfer to crop
- ✓ Transfer to packing cartons
- ✓ Transfer to harvest surfaces

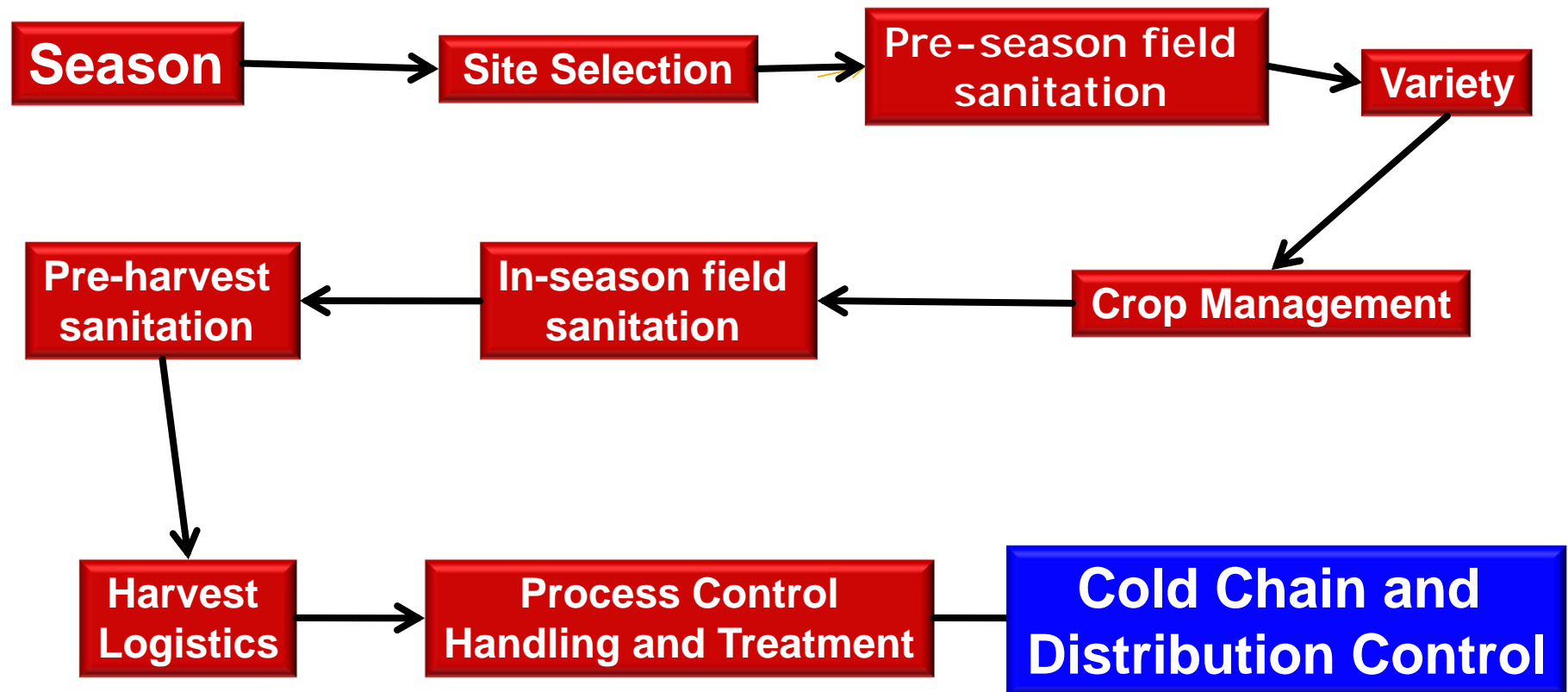
Fresh Cut Processes Have High Potential for Cross Contamination



Postharvest water quality management and internal surveillance has improved in the past 5 years



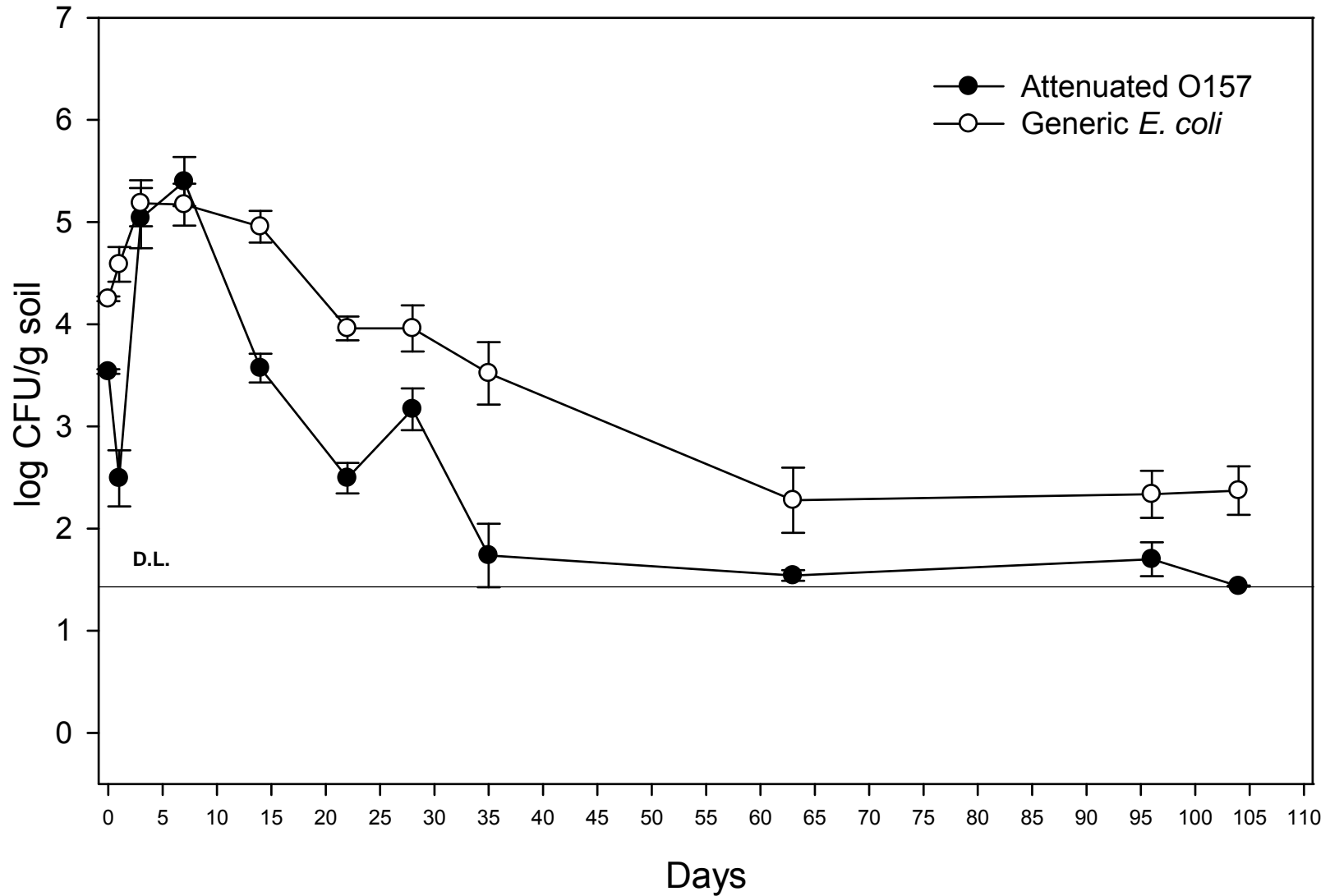
From the Beginning, Variable Risks Along the Supply-Chain were Recognized



On-farm Research Example

**Survival of Human Pathogens
in Soil-Crop Residues-
Replanted Spinach**

SVR-59 (2010) Survival of Generic and Attenuated O157:H7 *E. coli* After Incorporation of Spray-Inoculated Spinach



Inoculum Concentration

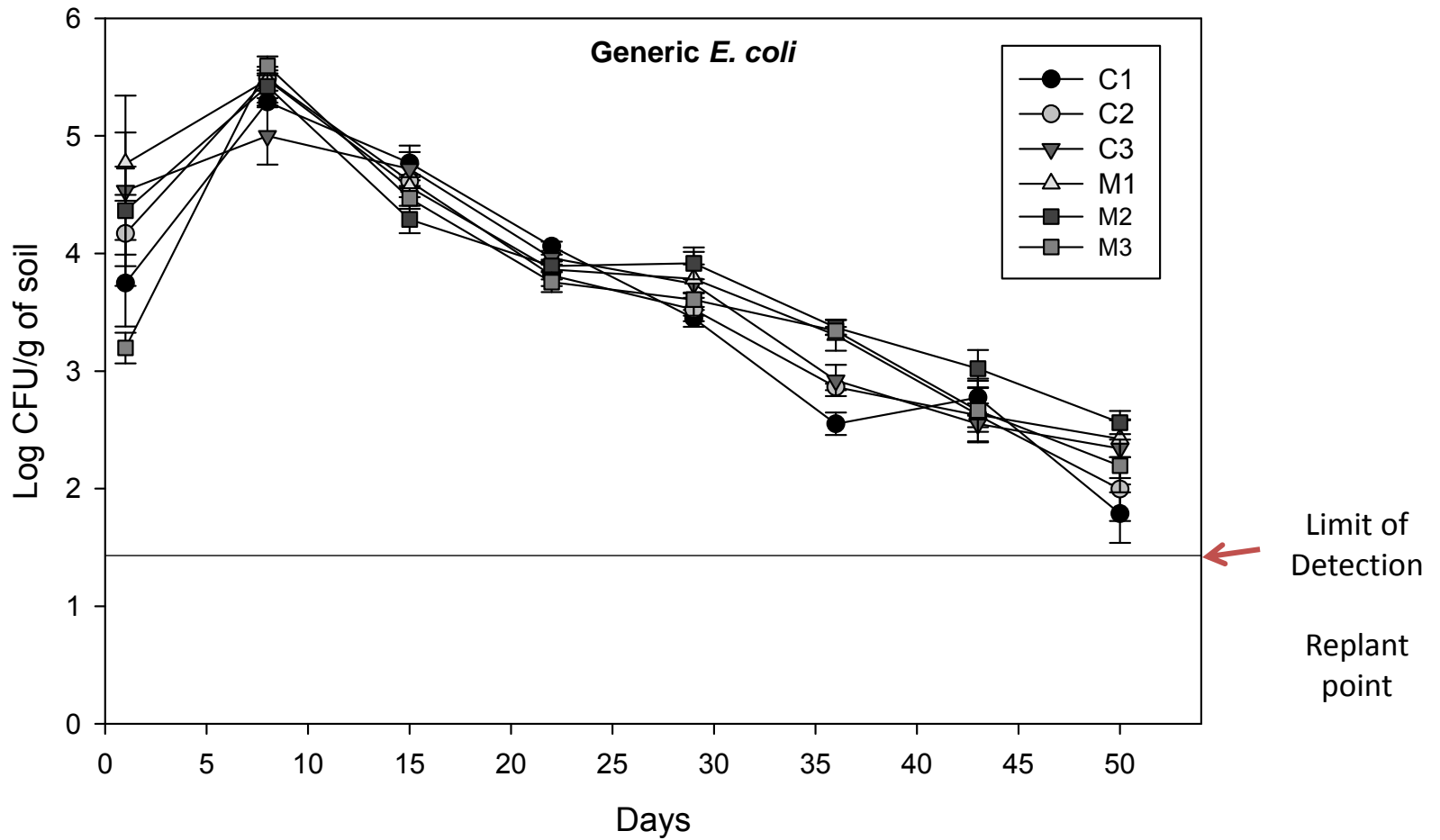
Attenuated cocktail: 7.94 CFU/ml

Generic *E. coli* cocktail: 8.23 CFU/ml

D.L.: Detection Limit of log 1.43 cfu/g

Generic *E. coli* cocktail

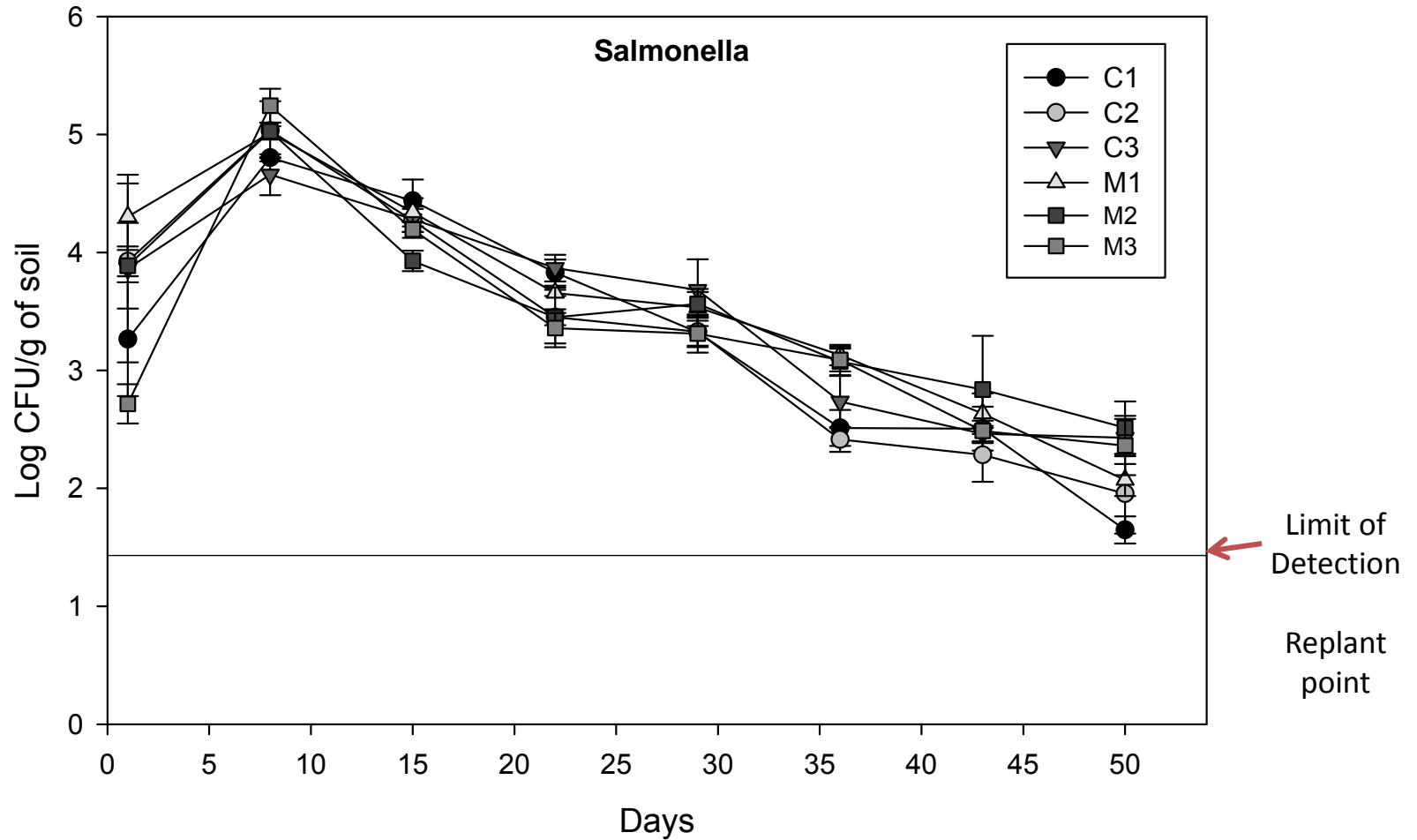
Spinach: Soil Residue Survival



Koike, Murphy, Sbdio, Cahn, and Suslow unpublished data 2011

Attenuated *Salmonella enterica* sv Typhimurium

Spinach Soil Residue Survival



Koike, Murphy, Sbdio, Cahn, and Suslow unpublished data 2011

Residual Applied Bacteria in Soil are Detected on Replanted Spinach: Fall 2011

Harvest
2-3 lvs
stage

	E. coli	Salmonella
C1	5/12	6/12
C2	5/12	7/12
C3	5/12	6/12
Total	15/36	19/36

	E. coli	Salmonella
C1	42%	50%
C2	42%	58%
C3	42%	50%
Total	42%	53%

Harvest
4-6 lvs
stage

	E. coli	Salmonella
C1	3/12	8/12
C2	5/12	6/12
C3	4/12	4/12
Total	12/36	18/36

	E. coli	Salmonella
C1	25%	67%
C2	42%	50%
C3	33%	33%
Total	33%	50%

Summary



- Fresh fruits and vegetables
- have be associated with significant foodborne illness
 - Illness to Total Servings per Year ratio is staggeringly small
- Pathogens associated with fruits and vegetables are linked directly or indirectly with human or animal feces
- Prevention throughout the supply chain is preferred
- The benefits of consumption of produce, fresh or further processed, remains an important consumer message
- Much remains to be done to earn consumer trust and confidence