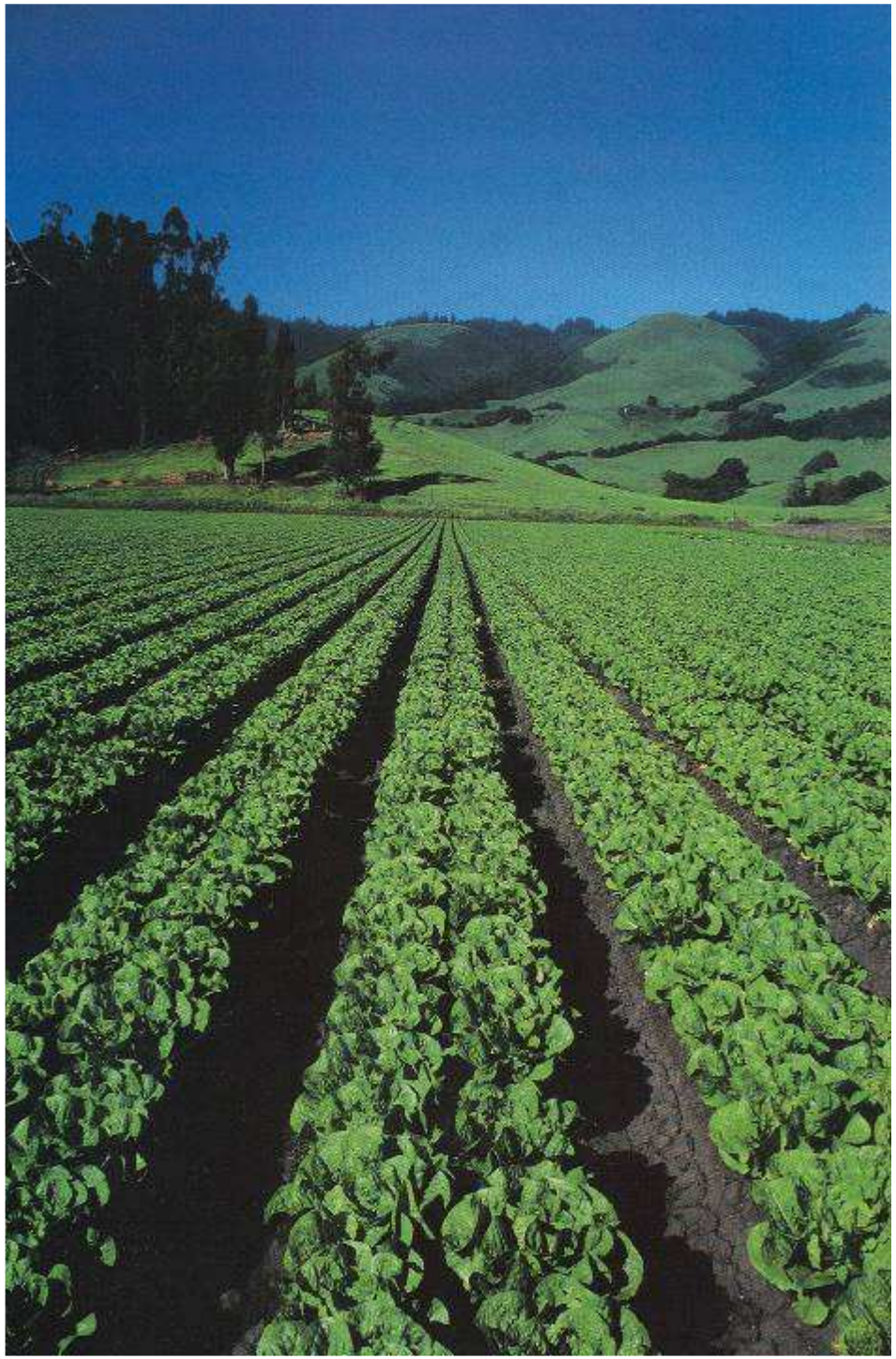

Good Agricultural Practices

UCDAVIS PLANT SCIENCES

Jim Gorny, Ph.D.
Executive Director

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Spinach Crisis 2006

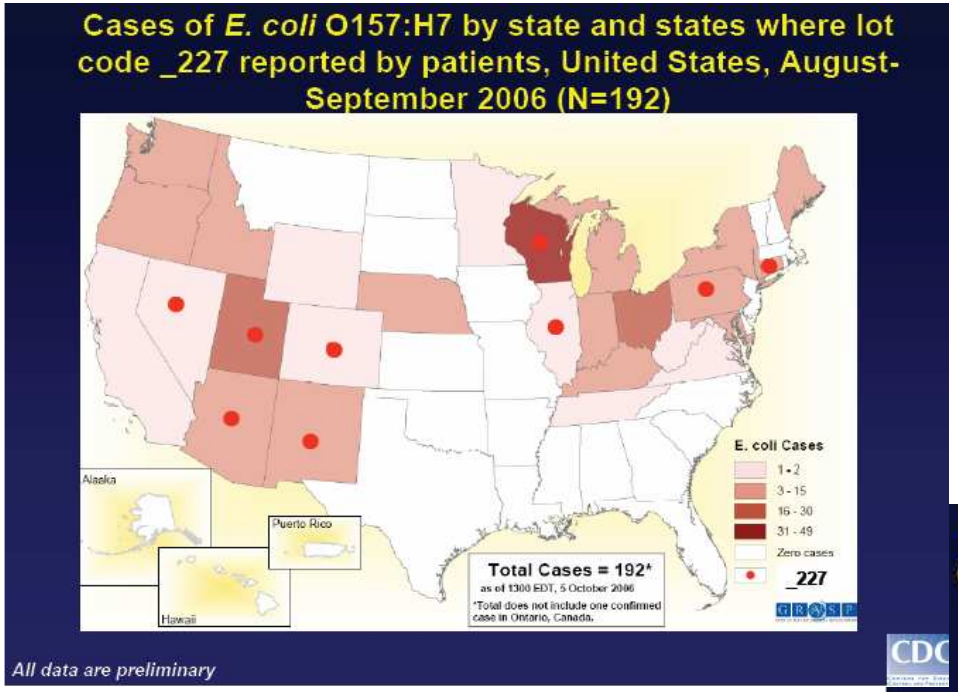
Thursday September 14, 2006
FDA Warning on Serious Foodborne *E.coli* O157:H7 Outbreak

"FDA advises that consumers not eat *bagged fresh spinach* at this time."
50 illness, 8 HUS, 1 Death, 8 States

- **All retail and food service product pulled from shelves.**
- **Distribution chain stopped in motion.**
- **Harvesting / processing stopped.**
- **Planting decisions on hold.**
- **An entire industry shut down.**

Kyle Allgood
Jane Dunning
Marion Graff

Anatomy of an Outbreak

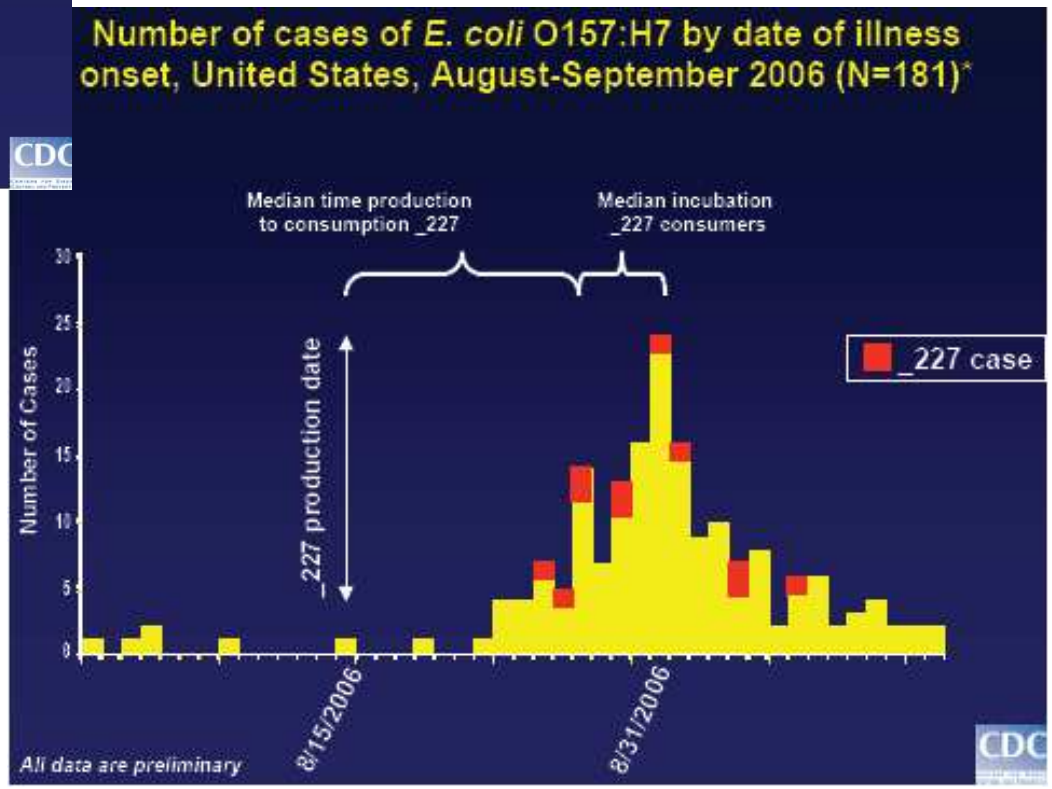


204 Illnesses

31 HUS

104 Hospitalizations

3 Deaths



26 States

5 Recalls

11 Bags from

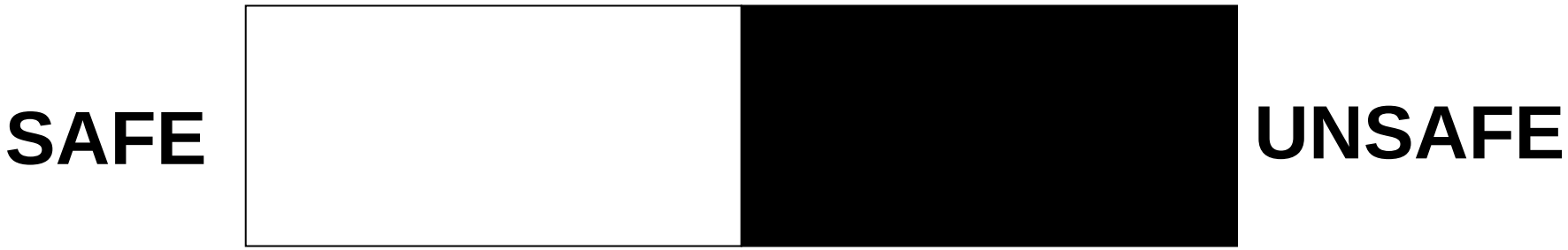
Lot 227 test +

Defining Safety

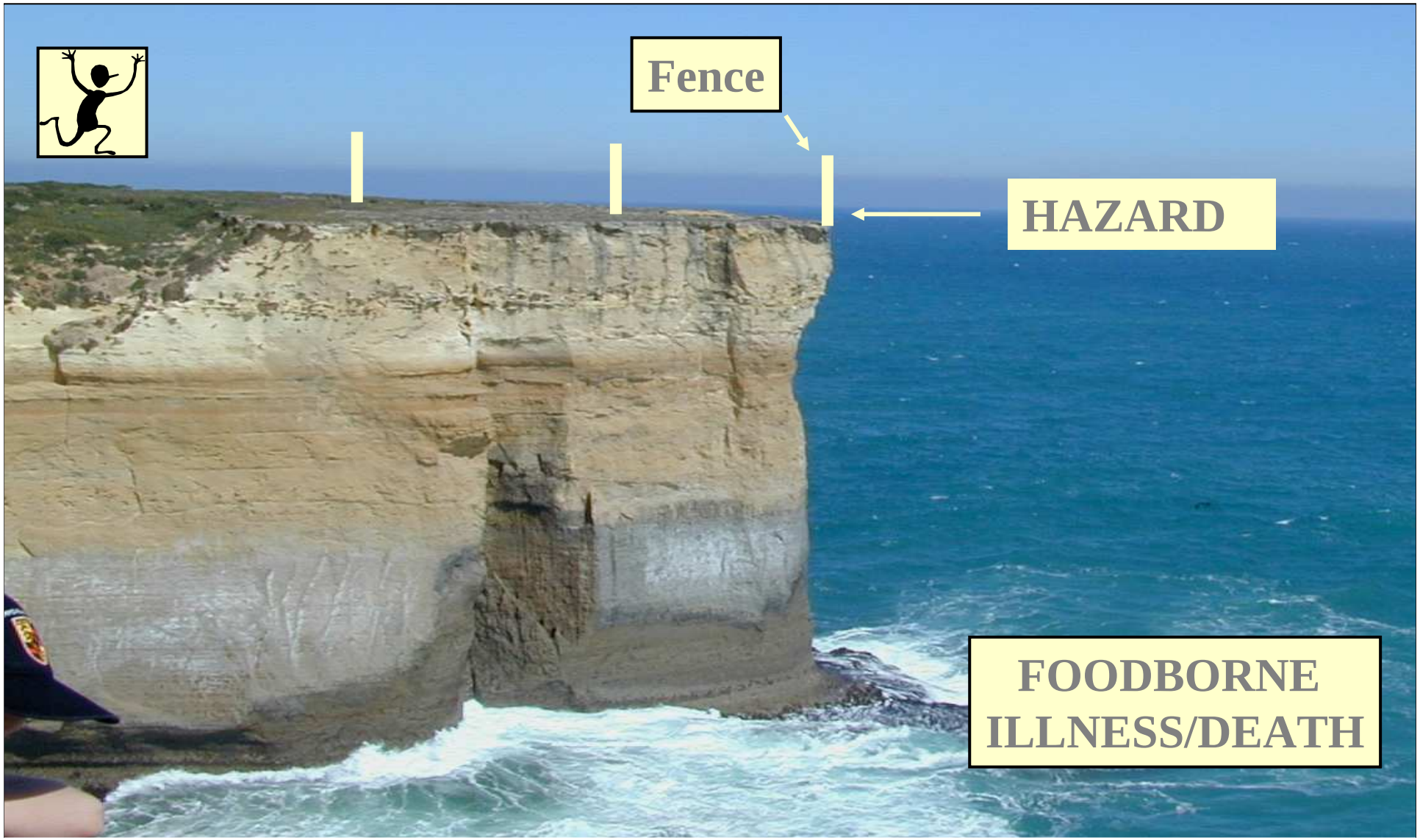
The goal of all food safety programs is: zero illnesses.

Food safety programs identify and manage risks (i.e. potential hazards).

Produce Food Safety = Prevention



Food Safety Programs
Control, Reduce or Eliminate Hazards



Practices, Possibilities and Controls

Practices

- Important to understand current practices.
- Practices are rapidly and ever changing.
- Many variations.

Possibilities

- Practices determine the risk profile.

Controls

Problem solving is needed.

- Problem definition (identify need)
- Constraints,
- Alternative Solutions,
- Analysis,
- Decision,
- Iterate

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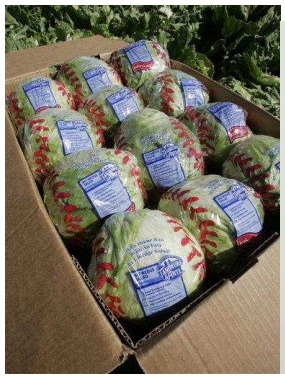
The Lettuce & Leafy Greens Category

Iceberg Lettuce
Romaine Lettuce
Green Leaf Lettuce
Red Leaf Lettuce
Butter Lettuce
Baby Leaf Lettuce (i.e., immature lettuce or leafy greens)
Escarole
Endive
Spring Mix
Spinach
Cabbage
Kale
Arugula
Chard



RACs Vs Value-Added Vs RTE

The Lettuce & Leafy Greens Category

- CA and AZ account for 94% of U.S. lettuce acreage head (196k acres), leaf (41k acres) and romaine (29k acres)

Source: USDA NASS

Other Growing Regions

CO, FL, NY, NJ, OH
Mexico, Canada
& Other Regions

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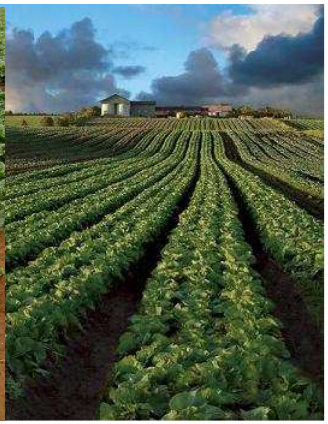
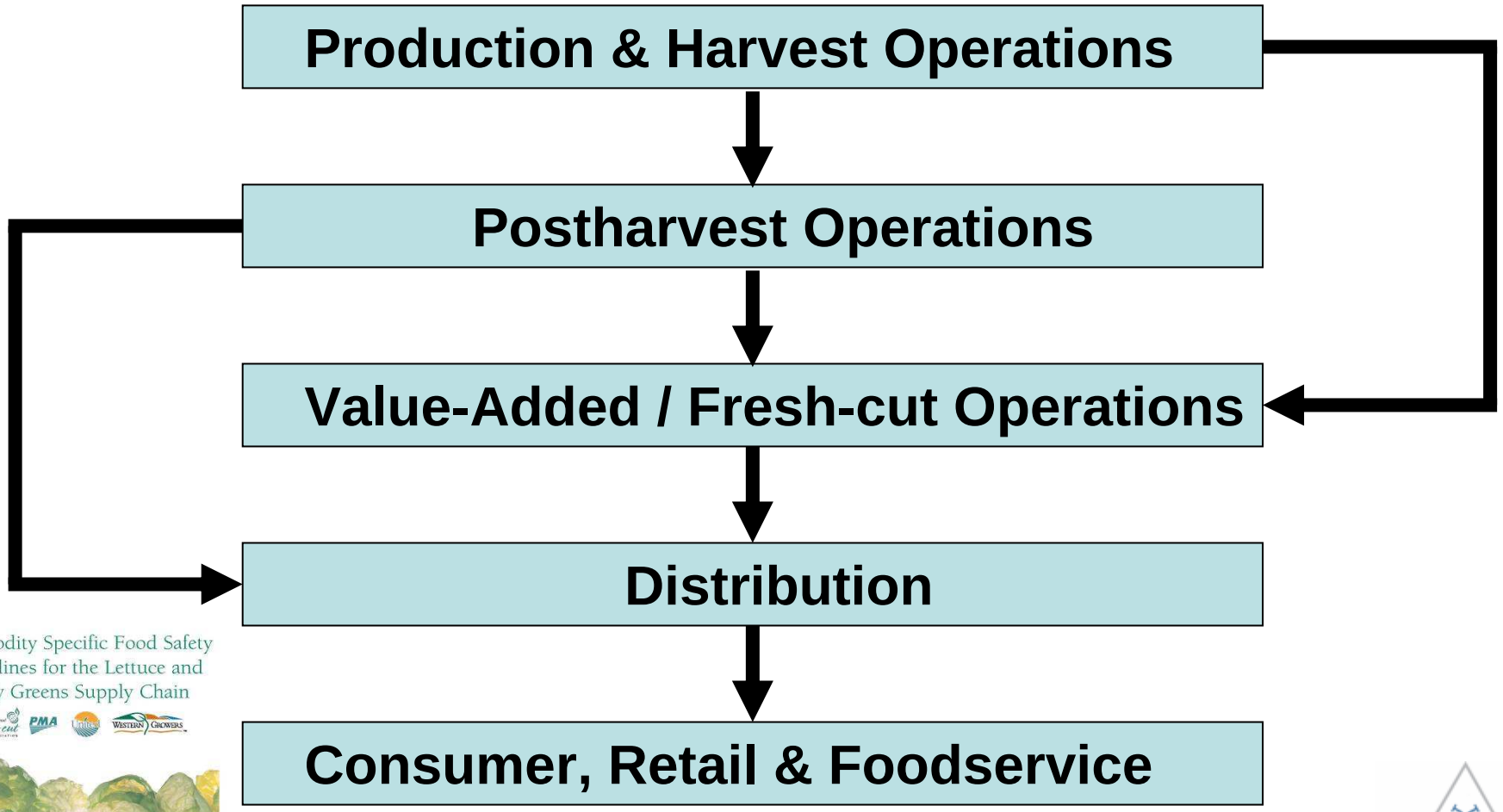
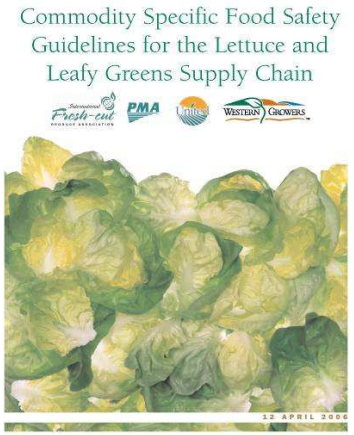


Lettuce & Leafy Greens Production & Handling





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Produce Food Safety

Practices
Possibilities
Controls

1. What are the significant human pathogen reservoirs.
2. What are the vectors of human pathogen transfer to LLG.
3. Environmental affects on survival or growth of human pathogens.
4. Survival and growth requirements for human pathogens on LLG.
5. Effective microbial sampling schemes and interventions.

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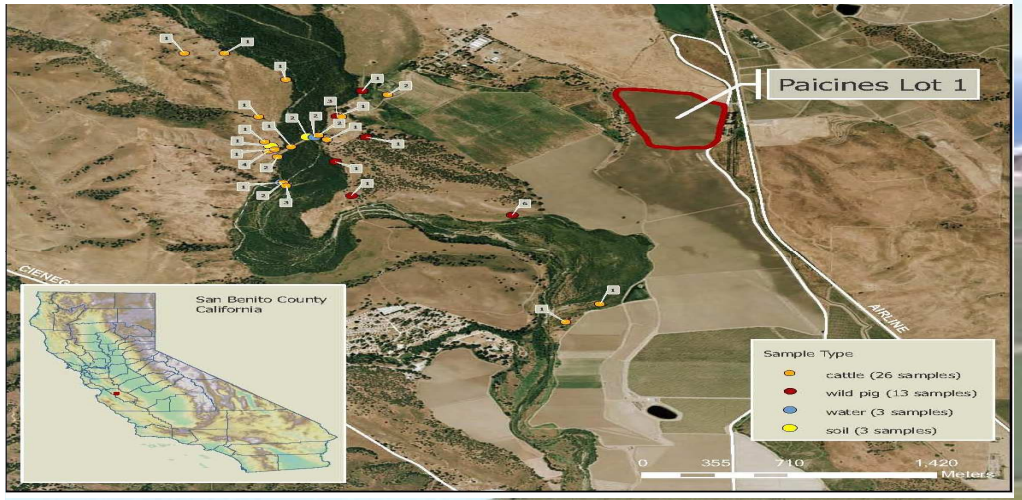
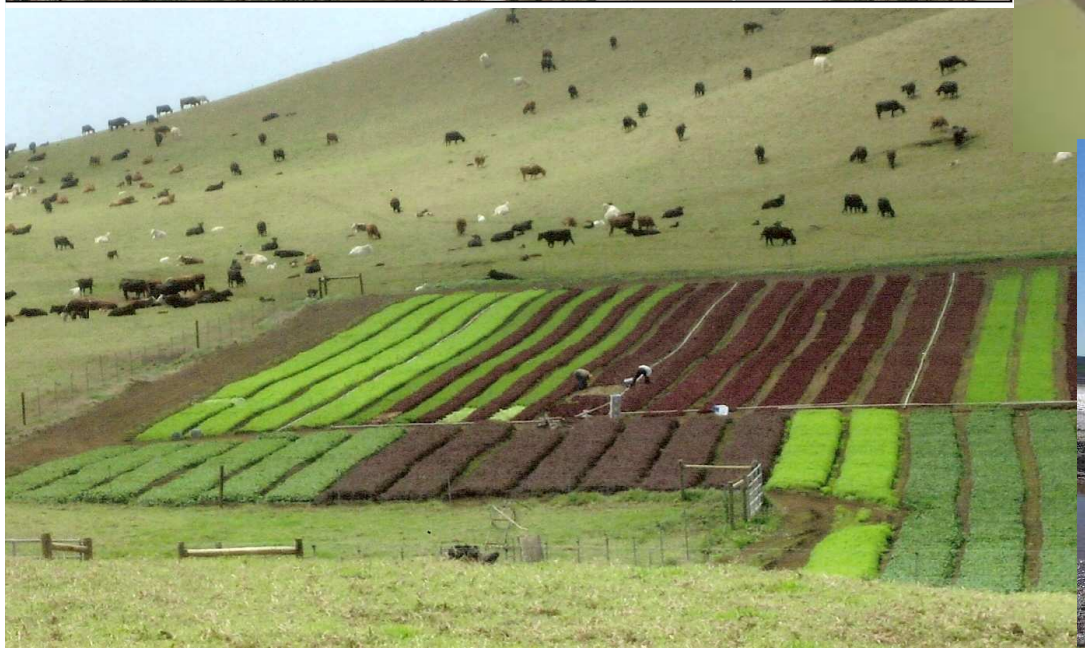
Production & Harvest

Practices: Site Selection & Adjacent Land Use





Production & Harvest

Possibilities: Site Selection & Adjacent Land Use

Site Selection

- ❖ Range Land
- ❖ Crop Production
  Land that has been Grazed
- ❖ Flooded Ground

Adjacent Land

- ❖ Forest
- ❖ Riparian Environment
- ❖ Farm Land
- ❖ Urban Interface
- ❖ Composting Operations
- ❖ Sewage Treatment Facilities

1. What are the significant human pathogen reservoirs.
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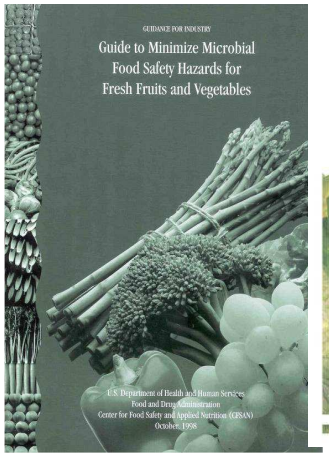
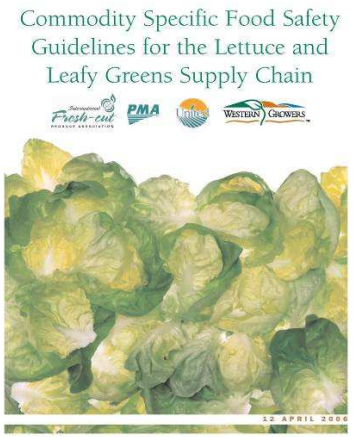
Production & Harvest

Controls: Site Selection Flooded Ground

- **Harvest Distance From Flooding**
- **Verification**
- **Formerly Flooded Ground**
  - Production Practices To Reduce Risks
  - Time Interval
  - Micro Testing to Validate Process





COMMODITY SPECIFIC FOOD SAFETY GUIDELINES FOR THE PRODUCTION AND HARVEST OF LETTUCE AND LEAFY GREENS

JUNE 5, 2007

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Production & Harvest

Controls: Adjacent Land Use

Proximate Safe Distance

Potential Contamination Source

Mitigation Measures / Risk Factors

Risk Factors

- Composting Operations
- CAFO's
- Compost On Adjacent Farms
- Grazing Lands
- Leach Fields
- Fallow Areas (Woods, etc.)

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Production & Harvest

Practices: Site Preparation






Production & Harvest

Possibilities: Site Preparation

- Field-to-field farm machinery pathogen transference?
- Variables affecting effective treatment of animal manure containing soil amendments?
- Water of appropriate microbial quality for emergence and soil preparation?

1. What are the significant human pathogen reservoirs.
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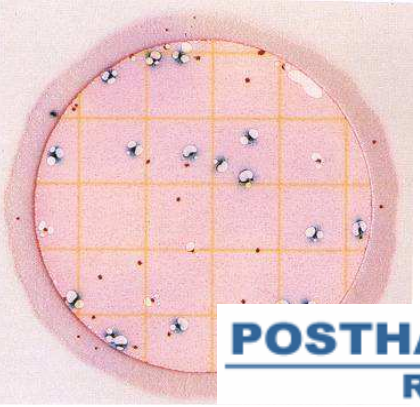
Production & Harvest

Controls: Site Preparation – Soil Amendments

- Physical, Chemical or Biological Treatment
- Output Micro Testing to Verify Process
- Application Interval



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Production & Harvest

Practices: Production

POSTHARVEST TECHNOLOGY
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Production & Harvest

Practices: Production



WATER



Production & Harvest

Possibilities: Production

- Water of appropriate microbial quality for irrigation?
- What factors effect pathogen persistence and growth in irrigation water?
- How effectively are pathogens transferred by water uses?
- Does the irrigation method used alter pathogen transference risk?
- If pathogens are transferred to LLG what environmental factors and production practice effect survival and growth of human pathogens?
- Root uptake? Contaminated seed?

What are the significant human pathogen reservoirs.
What are the vectors of human pathogens transfer to LLG.
Environmental affecting survival or growth of human pathogens.
Survival and growth requirements for human pathogens on LLG.
Effective microbial sampling schemes and interventions.

Production & Harvest

Controls: Production - Water

- Microbial Action Levels Based on Safe and Sanitary Intended Use
- Testing Frequency Based on Source Variability
- Microbial Indicators Used To Measure System Performance (generic *E. coli*)
- Decision Tree Based Actions

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Production & Harvest

Controls: Production - Water

- **PREHARVEST Foliar Applications**
  Edible Portions of the Crop ARE Contacted by Water (e.g. overhead sprinkler irrigation, pesticides/fungicide application, etc.)
  geo mean<126 CFU/100ml single sample <235 CFU/100ml
- **PREHARVEST Non-foliar Applications**
  Edible Portions of the Crop are NOT contacted by Water (e.g., furrow or drip irrigation, dust abatement water)
  geo mean<126 CFU/100ml single sample<576 CFU/100ml
- **POSTHARVEST Direct Product Contact or Food Contact Surfaces** (e.g. re-hydration, core in field, harvest equipment cleaning, bin cleaning, product cooling, product washing) <2 MPN/100ml

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Production & Harvest

Controls: Production - Water

- **Stop Using the Water Source**
- **Perform a Sanitary Survey**
- **Take Corrective Actions**
- **If Water Has Been Used for Crop Production**
  test produce for pathogens (*E.coli* O157:H7, *Salmonella*)

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Sampling Error – False Negatives

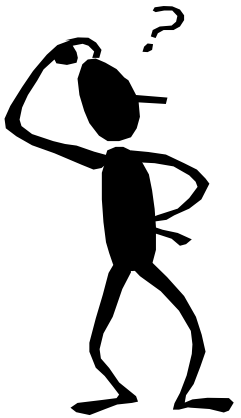
Table 1. Probability of <u>accepting</u> a defective lot with indicated proportion of defective sample units

	Number of Sample Units			
% Defective	**15**	**30**	**60**	**100**
0.1	0.99	0.97	0.94	0.90
0.5	0.93	0.86	0.74	0.61
1	0.86	0.74	0.55	0.37
2	0.74	0.55	0.30	0.13
5	0.46	0.21	0.05	0.01

Adapted From: Microorganisms in Foods 7 - Microbiological Testing in Food Safety Management, 2002 International Commission on Microbiological Specifications for Foods (ICMSF) Kluwer Academic / Plenum Publishers NY, NY

<u>Example 1</u>
Defect Level: 0.5%
Samples Units Tested: 30
Analysis: 86% probability that all 30 samples will be found negative and the lot will be accepted.

<u>Example 2</u>
Defect Level: 0.7%
Number of samples required to detect the defect with 95% probability: 428 sample units
Number of samples required to detect the defect with 90% probability: 329 sample units



Sampling Error - False Positives & Re-Testing

Probability of Detecting an Initial Positive,
Then Finding a Second When the Lot is Retested

Initial Positive	Both Initial & Retest Positive
1 in 2	1 in 4
1 in 10	1 in 100
1 in 50	1 in 2,500
1 in 100	1 in 10,000

Adapted From: Microorganisms in Foods 7 – Microbiological Testing in Food Safety Management, 2002 International Commission on Microbiological Specifications for Foods (ICMSF) Kluwer / Plenum Publishers NY, NY

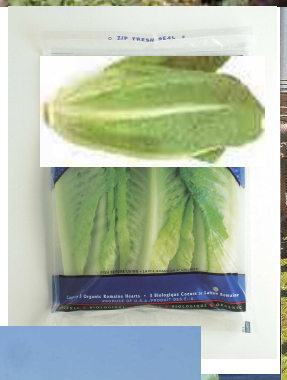
Production & Harvest

Practices: Harvest












Production & Harvest

Possibilities: Harvest

- Do new harvest methods increase or decrease risk?
- Pathogen reservoirs: workers, adjacent land, animal feces?
- How effectively are human pathogens transferred to LLG's by worker, food contact surface the environment?
- What factors can effect human pathogens survival and growth on LLGs during/after harvest operations?
- If human pathogens are transferred to LLG at harvest what environmental factors and handling practices effect survival and growth?

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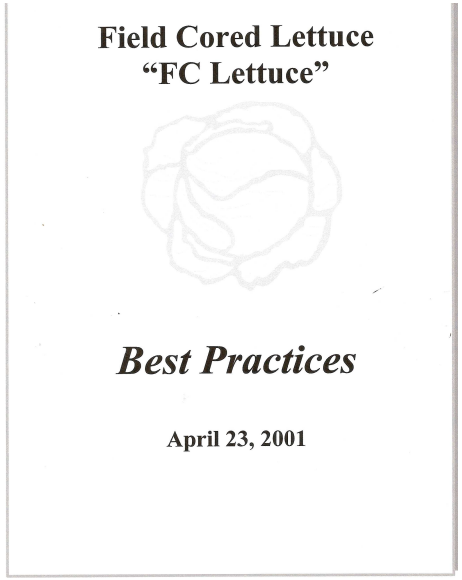
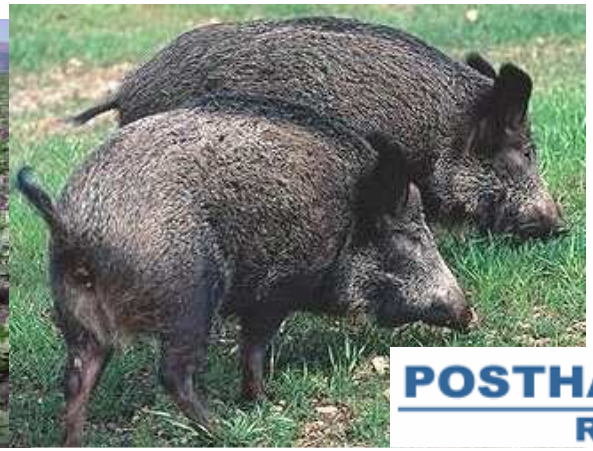
Production & Harvest

Controls: Harvest

- Decision Tree Based Actions
  - Pre-Harvest Assessment
  - Harvest
- Environmental Assessment
- Evidence of Animal Intrusion
- Harvest Distance From Intrusion
- Verification
- Cleaned & Cored Guidelines





POSTHARVEST TECHNOLOGY
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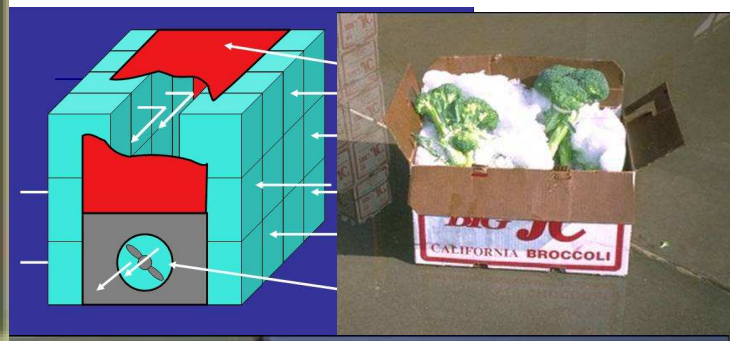
Postharvest Operations

Practices: Postharvest Cooling



Postharvest Operations

Possibilities: Postharvest Cooling

- What are the sources and vectors of pathogens in the postharvest environment?
- How well can human pathogens persist or grow in this environment?
- What factors can effect human pathogens survival and growth on LLGs during/after postharvest operations?
- If human pathogens are transferred to LLG at harvest what environmental factors and handling practices effect survival and growth?
- Time/Temperature for Safety?

1. What are the significant human pathogen reservoirs.
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Postharvest Operations

Controls: Postharvest Cooling

- GAPs/GMPs/Sanitation/Employee Hygiene Programs
- Use of High Quality Water.
- Preventing Cross Contamination.

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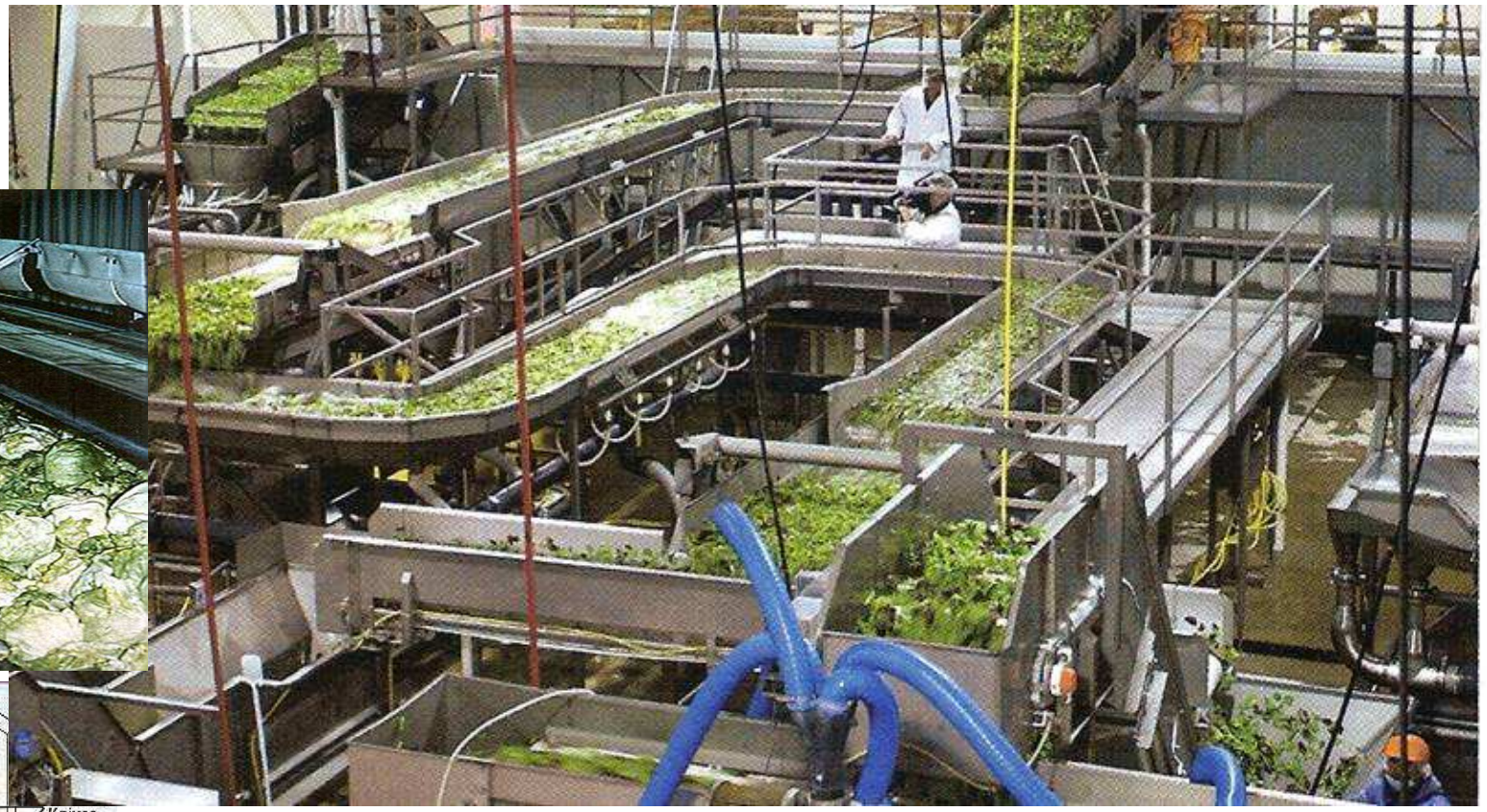
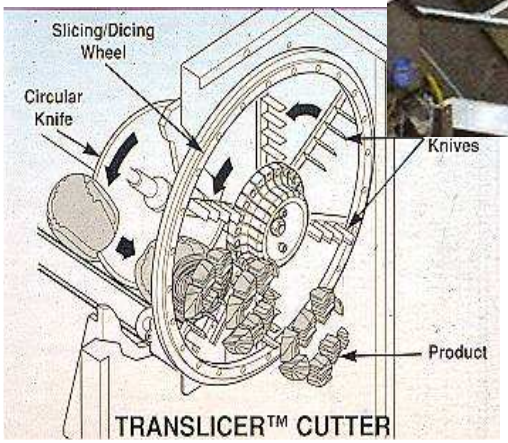
Value Added /Fresh-cut Operations

Practices: Value Added / Fresh-cut





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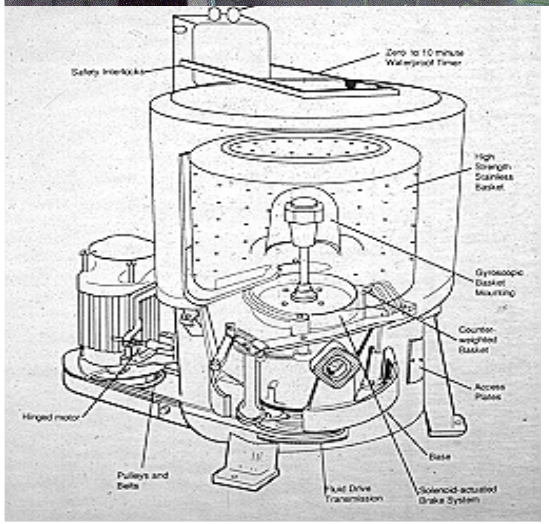
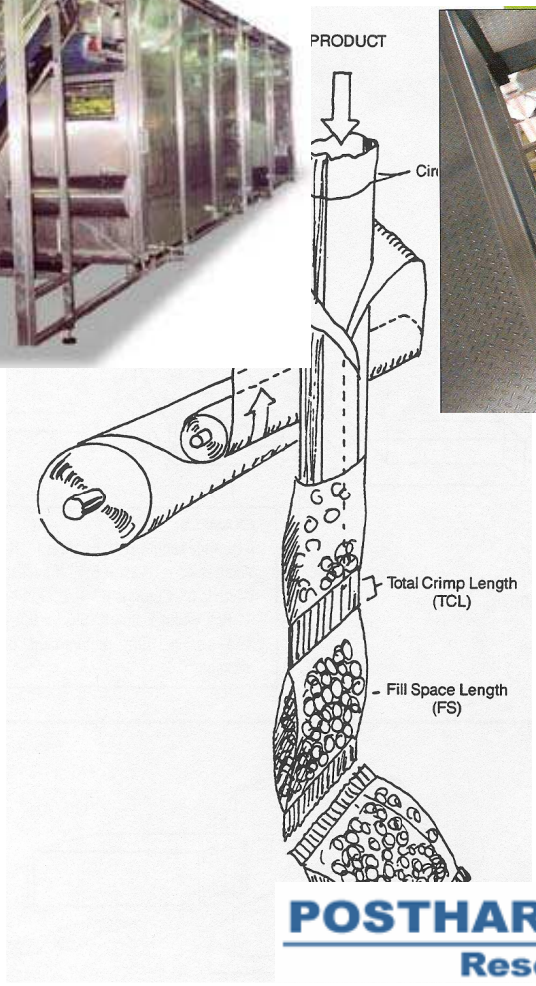
Value Added /Fresh-cut Operations

Practices: Value Added / Fresh-cut





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Value Added /Fresh-cut Operations

Possibilities: Value Added / Fresh-cut

- What are the sources and vectors of pathogens in the processing environment?
- How well can human pathogens persist or grow in this environment?
- What factors can effect human pathogens survival and growth on LLGs during/after processing operations?
- If human pathogens are transferred to LLG at harvest what environmental factors and handling practices effect survival and growth?
- Time/Temperature for Safety?

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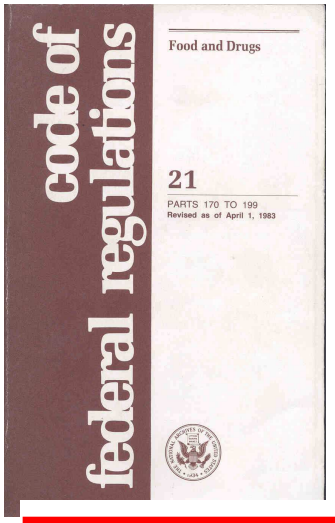
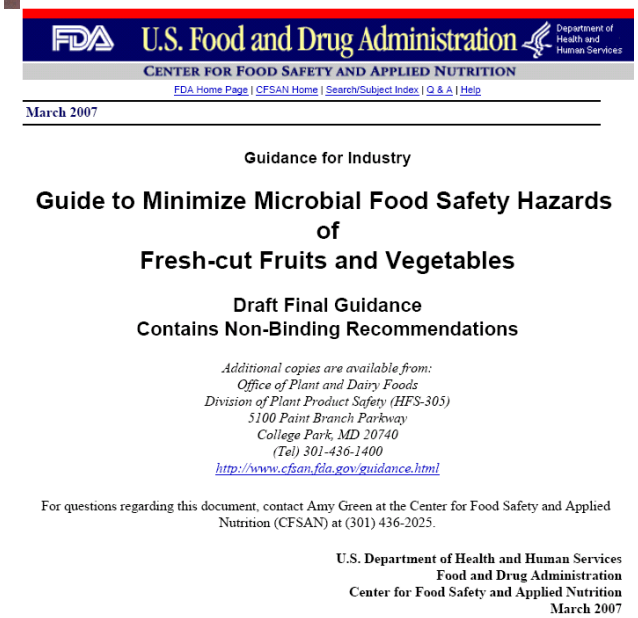
Value Added /Fresh-cut Operations

Controls: Value Added / Fresh-cut




FDA U.S. Food and Drug Administration
Department of Health and Human Services
CENTER FOR FOOD SAFETY AND APPLIED NUTRITION
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March 2007

Guidance for Industry

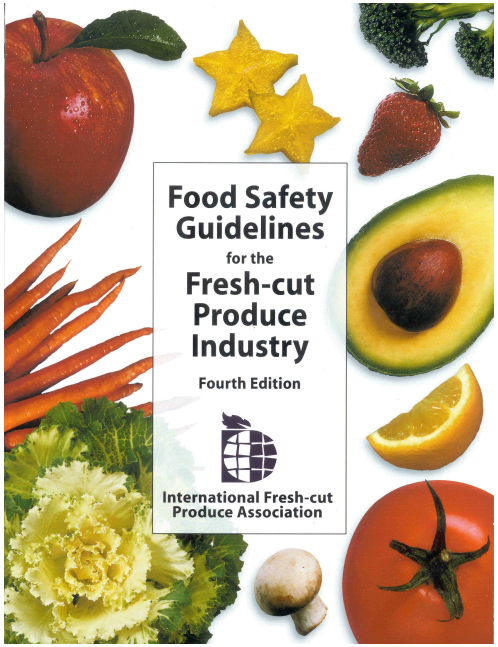
Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables

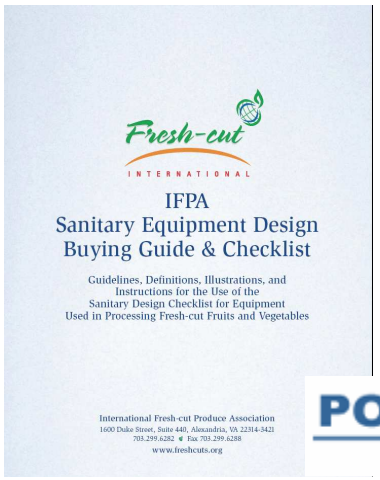
Draft Final Guidance
Contains Non-Binding Recommendations

Additional copies are available from:
Office of Plant and Dairy Foods
Division of Plant Product Safety (HFS-305)
5100 Paint Branch Parkway
College Park, MD 20740
(Tel) 301-436-1400
http://www.cfsan.fda.gov/guidance.html

For questions regarding this document, contact Amy Green at the Center for Food Safety and Applied Nutrition (CFSAN) at (301) 436-2025.

U.S. Department of Health and Human Services
Food and Drug Administration
Center for Food Safety and Applied Nutrition
March 2007





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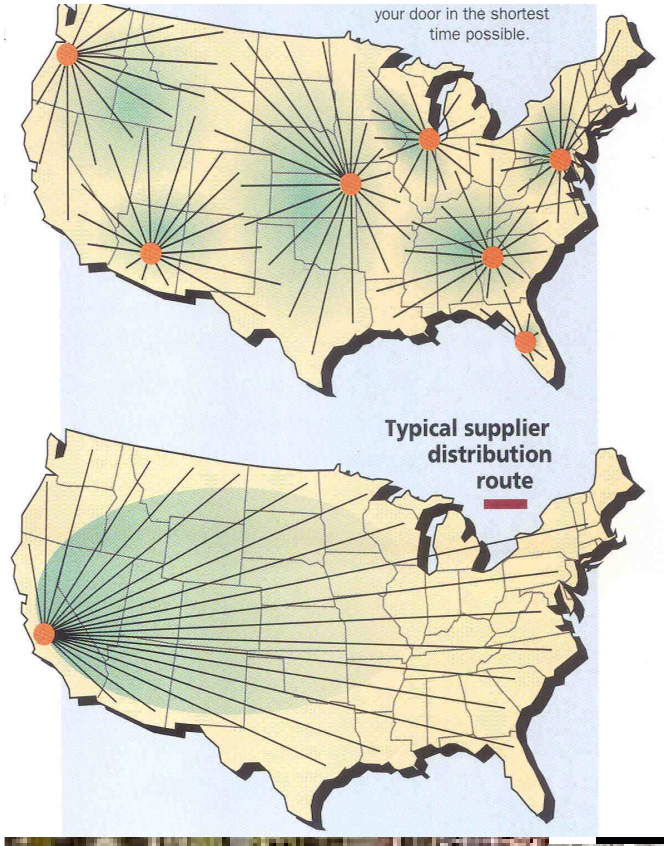
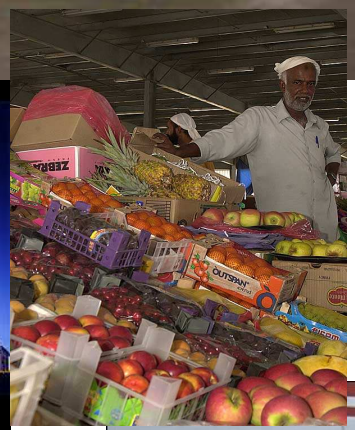
Distribution

Practices: Distribution





Distribution

Possibilities: Distribution

- What are the sources and vectors of pathogens in the distribution environment?
- How well can human pathogens persist or grow in the distribution environment?
- What factors can effect human pathogens survival and growth on LLGs during distribution operations?
- If human pathogens were transferred to LLG what environmental factors and handling practices effect survival and growth?
- Time/Temperature for Safety?

1. What are the significant human pathogen reservoirs.
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Distribution

Controls: Distribution

- GMPs/Sanitation/Employee Hygiene Programs
- Preventing Cross Contamination.

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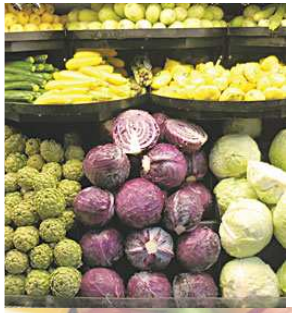
End User, Retail, Food Service, Consumers

Practices: End User









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End User, Retail, Food Service, Consumers

Possibilities: End User

- Preventing Cross Contamination During Preparation (People, Other Raw Food Products)?
- Water Misters?
- Re-crisping Operations – Internalization?
- Time / Temperature Control?

1. What are the significant human pathogen reservoirs.
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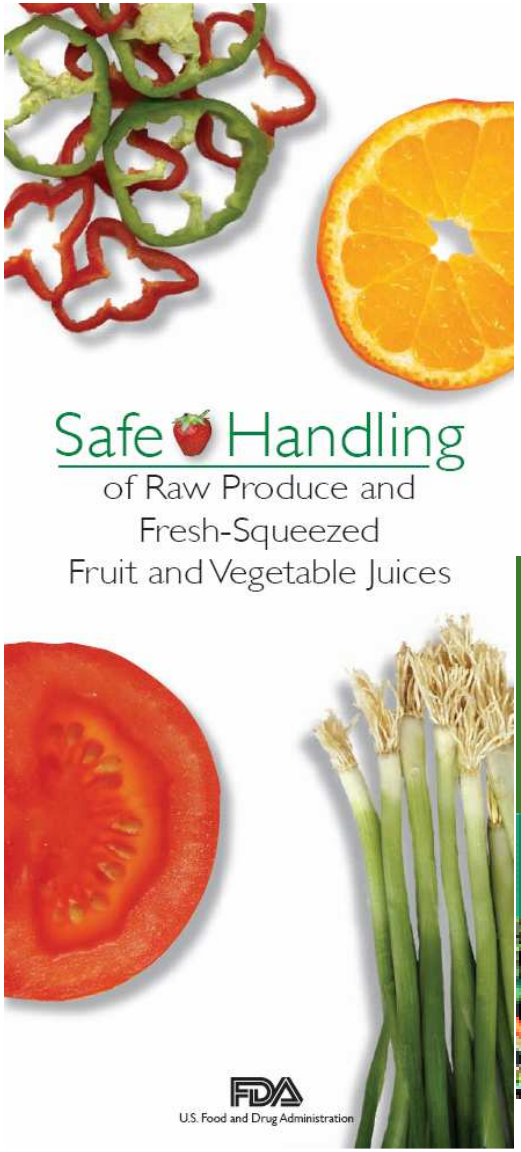
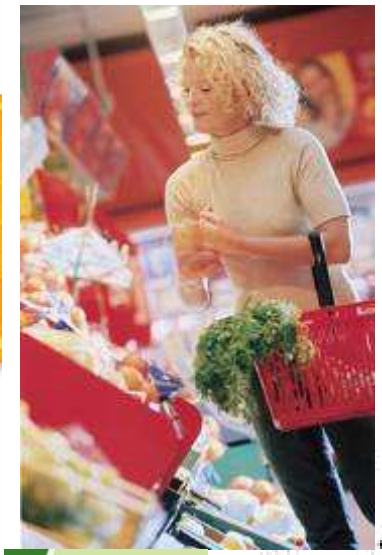
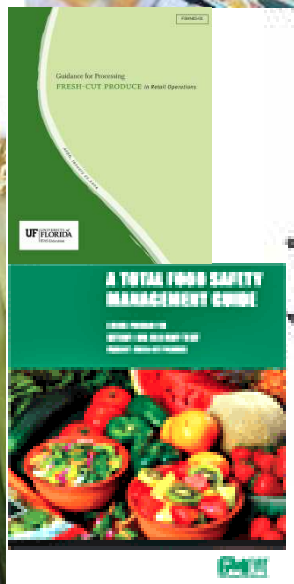
End User, Retail, Food Service, Consumers

Controls: End User





ServSafe



POSTHARVEST TECHNOLOGY
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Produce Food Safety Priority Research Topics

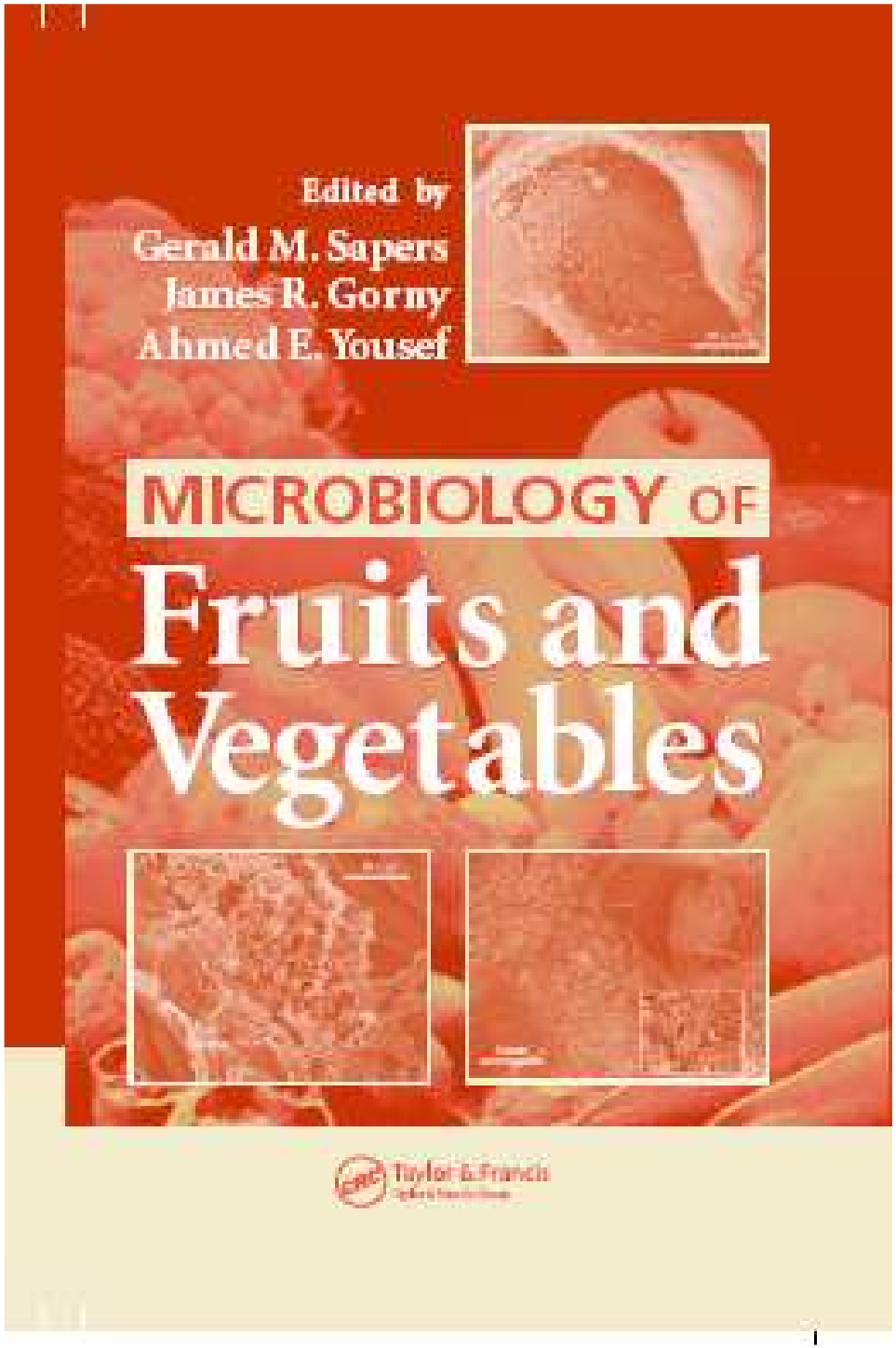
- Introduction of human pathogens into the environment where fresh produce is grown, harvested, and undergoes postharvest handling and distribution.

- Survival and possible growth of human pathogens in the environment during growing, harvest, postharvest handling, processing and distribution of fresh and fresh-cut produce.

- Mechanism of transference of human pathogens to fresh produce edible plant surfaces during growing, harvest, postharvest handling, processing and distribution operations.

- Survival and possible growth of human pathogens on produce during growing, harvest, postharvest handling, processing and/or distribution.

- Effective microbial sampling schemes and intervention strategies.



La nueva publicación: "Tecnología Postcosecha de Cultivos Hortofruticolas

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