

Got Muskmelon. . .Got Food Safety Risk?



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Muskmelon Production

Critical Points

- Critical points:
 - Tender warm season crop
 - Warm weather & soils
 - Planting too early can:
 - Reduce crop stand
 - Take more time
 - Sugar sells!
 - At harvest want 12-14% sugar
 - Sunlight dependent
 - Cloudy weather = low sugar
 - Crop canopy critical
 - Source of sugars
 - Harvest at ½ slip



Cultivars

- Consider
 - On-farm trialing
 - Market demands
- Caravelle F₁ hybrid
 - Willhite
 - Round sutureless
 - 3.5 lbs.
- Cruiser F₁ hybrid
 - Harris Moran
 - Round sutureless
 - 4-5 lbs., some PM resistance
- Gold Rush F₁ hybrid
 - Harris Moran
 - Round sutureless
 - 3.5-4.5 lbs., some PM resistance



http://www.harrismoran.com/products/melon/pdf/USA_2013_TS_Melon_Cruiser.pdf

More Cultivars

- Navigator F₁ hybrid
 - Harris Moran
 - Round sutureless
 - 4-6 lbs., musky flavor
 - Fusarium resistance
 - Some PM resistance
- Super 45 F₁ hybrid
 - Willhite
 - Round sutureless
 - 3 lbs.
 - Some PM resistance




http://www.harrismoran.com/products/melon/pdf/USA_2013_TS_Melon_Navigator.pdf

Fertility

- Fertility (base on soil test)
 - Slightly acidic 6.0-6.8 pH
 - Below 6.0 = weak plants
 - N-P-K 125-65-250
 - Apply P & K during soil prep
 - Nitrogen
 - 50 lbs. preplant
 - 50 lbs. at vining
 - 25 lbs. as potential reserve in low N soils
 - Alternative:
 - Apply through drip irrigation

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SOIL, WATER & FORAGE ANALYTICAL LABORATORY
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SOIL TEST REPORT

<p>LYNN BRANDENBERGER OSU VEGETABLES HORTICULTURE DEPT 360 AG HALL CAMPUS MAIL,</p>	<p>Name:</p> <p>Location:</p>	<p>Lab ID No.: 462052 Customer Code: 205 Sample No.: 1 Received: 5/17/2007 Report Date: 5/22/2007</p>
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- Routine Test -	- Secondary Nutrients -	- Micronutrients -
pH: 5.7	SO ₄ -S(lbs/A)	Fe (ppm):
Buffer Index: 7.0	Surface:	Zn (ppm):
NO ₃ -N(lbs/A)	Subsoil:	B (ppm):
Surface: 40	Ca (lbs/A):	Cu (ppm):
Subsoil:	Mg (lbs/A):	
Soil Test P Index: 72	- Additional Tests -	
Soil Test K Index: 303	OM (%): 0.60	

INTERPRETATION AND REQUIREMENTS FOR Cowpeas (YIELD GOAL = Not Needed)

- Test -	- Interpretation -	- Requirement -	- Recommendations and Comments -
pH	Adequate	No lime required	
Nitrogen	Adequate	None	
Phosphorus	Adequate	None	
Potassium	Adequate	None	
Organic Matter	Low		

 Signature

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Irrigation

- Estimated use:
 - 15-20 inches for crop
- Critical at:
 - Establishment
 - Fruit set & development
 - Excess at harvest < quality
- Methods:
 - Drip
 - Sprinkler
 - Furrow
- Drip & plastic mulch
 - Provide high level of control
 - Help manage water efficiently



Pest Management

- Pests
 - Rotate fields
 - 3 years or more between crops
 - Reduce disease & insect problems
 - Scouting is a critical need
 - Once or more per week
 - Weed control critical prior to vines running
 - Plastic mulches-drip irrigation
 - Shallow cultivation, maybe?
 - Herbicides

- Scout in X or V pattern



Pollinator Management

- Pollinators key to success
 - Essential for cucurbits
“Melons”
 - > \$15 billion/yr attributed to
pollinators
- Protect your pollinators
 - If < 1 bee/10 flowers additional
hives needed
 - Protect from pesticide apps.
 - Select less toxic materials
 - Reduce pesticide drift
 - Spray in evening up to midnight



Insect Management



<http://www.extension.umn.edu/garden/insects/find/squash-bugs/>

<http://www2.ca.uky.edu/entomology/entfacts/ef311.asp>



<http://www.ext.colostate.edu/pubs/insect/05609.html>

Black Cutworm Identification

Overall "greasy" appearance

Pale band along top of body

Paired spots uneven in size

Head with two black stripes

Pebbly skin texture



<http://www.ipm.ucdavis.edu/PMG/M/I-HO-MEUP-NM.006.html>

http://www.uky.edu/Classes/ENT/574/insects/tobacco_insects/cutworms/cutworms_images.htm



<http://www.killspidermite.co.uk/>

Disease Management



http://www.ces.ncsu.edu/depts/pp/notes/Vegetable/vdin011/img_leaf.html



<http://vegetablemdonline.ppath.cornell.edu/PhotoPages/Cucurbit/Gummy/GSB1.htm>



<http://www.omafra.gov.on.ca/IPM/english/cucurbits/diseases-and-disorders/fusarium-wilt.html>



<http://www.maine.gov/dacf/php/gotpests/diseases/images/downy-mildew-cucurbits/dmc-cantaloupe-big.jpg>



<http://vegetablemdonline.ppath.cornell.edu/PhotoPages/Cucurbit/Powdery/PowderyFS3.htm>



<http://ucce.ucdavis.edu/files/repository/calag/img4903p22b.jpg>

Weed Management

- Should include
 - Crop & weed history
 - Crop rotations
 - Cover crops
 - Crop selection
 - Irrigation
 - Mulches
 - Cultivation
 - Beneficial organisms
 - Herbicides



- Not all crops are equal!
 - Growth rates
 - Crop height
 - Shading ability
 - Cultivation options
 - Weed tolerance
 - Herbicide tolerance

Harvest

- Plan field layout considering harvest
- Days from planting to harvest 70-95
 - Depends on cultivar & weather
- Frequency
 - Every 2 days for up to 12-15 harvests
- Harvest at $\frac{1}{2}$ slip for max shelf life
 - $\frac{3}{4}$ or full slip if going direct to consumer
- Post-harvest care
 - Temp of 35-45°F
 - Can keep up to 2 weeks



<http://extension.missouri.edu/p/m173>

What About Muskmelon Food Safety?

- Everyone is affected
 - Our families
 - Our customers
- Important to food business
 - Food Safety Modernization act
 - < \$25,000 exempt
 - Other exemptions also
 - Regardless of FSMA & regs.
 - Food safety = staying in business
 - Customer driven



What's Unique About Muskmelon?

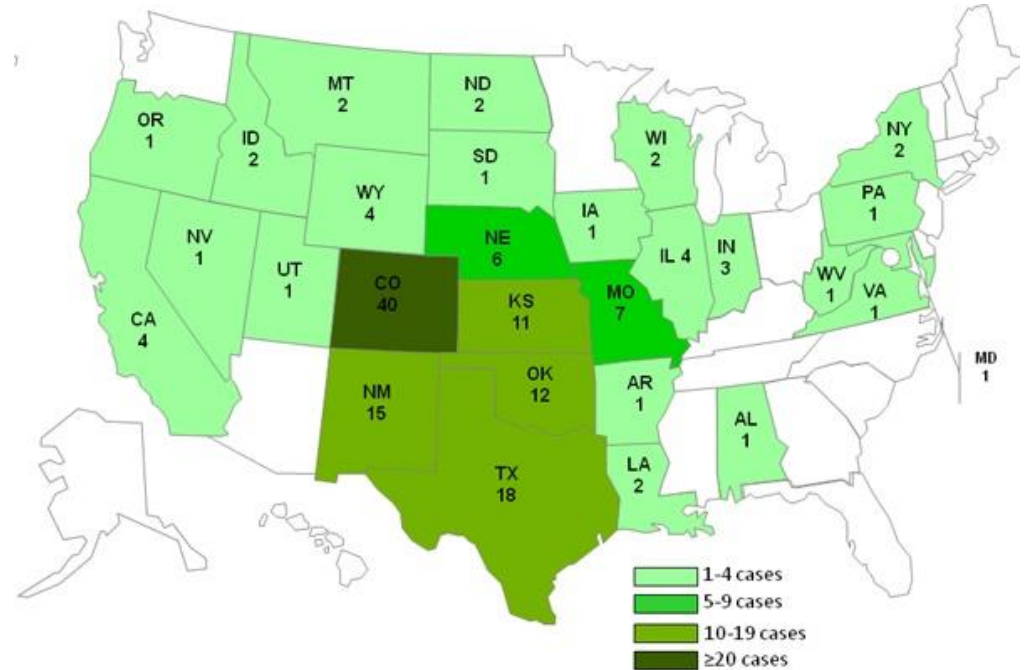
- Muskmelon is the “ride”
 - Transport for bacteria
- Muskmelon belongs to “reticulatus” group
 - Corky rind
 - Ideal environment for:
 - Bacteria & other food-borne pathogens
 - Nearly impossible to clean & sanitize



<http://www.wikihow.com/Cut-a-Cantaloupe>

2011 Listeriosis Outbreak

- 2011 Muskmelon outbreak
 - Jensen Farms
Granada, Colorado
 - No contamination found in field
 - Contaminated packing shed
 - Possibly from equip. or cull truck
 - 28 states affected
 - 147 infected
 - 30 deaths: >20% death rate
 - 99% were hospitalized



<http://www.cdc.gov/listeria/outbreaks/cantaloupes-jensen-farms/082712/map.html>



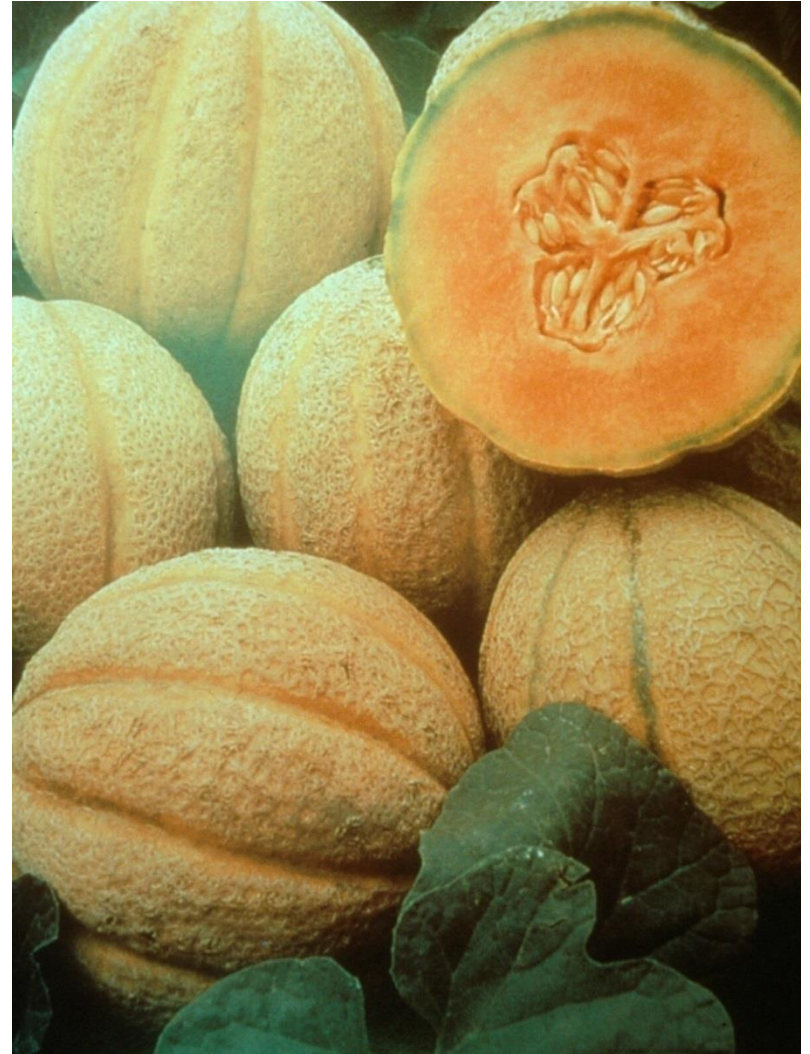
Background on Listeriosis

- Causal agent:
 - *Listeria monocytogenes*
 - Particularly nasty bacteria
 - Occurs naturally in soil, crop debris, animal manure
 - Will grow even under refrigeration



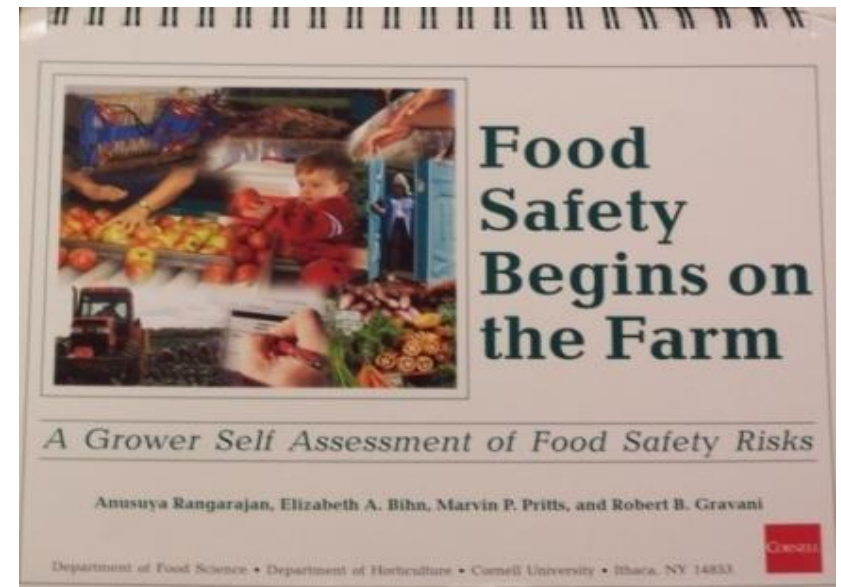
What Are Our Options?

- Option # 1
 - Quit growing muskmelon
 - Grow smooth-rind melons instead
- Option # 2
 - Wait for breeders to develop smooth-rind muskmelons
- Option # 3
 - Develop farm food safety program



Food Safety & Fresh Produce

- Realize this:
 - Food safety risks cannot be eliminated, but can be reduced significantly
- There is no one-size fits all program
 - Each farm is unique and also their food safety program
- Do a risk analysis
 - Grower self assessment of food safety risks
 - Available from National GAPS program at:
<http://www.gaps.cornell.edu/>



Farm Food Safety Program Consist of

- Assessment of food safety risks
- Use of Good Agricultural Practices (GAPs)
- Use of Good Handling Practices (GHPs)
- Records
 - Written plan
 - Recording what was done



Sources of Microbial Pathogens

- *Listeria monocytogenes*
- *Bacillus cereus*
- *Clostridium botulinum*
- *Clostridium perfringens*



- Human & animal intestinal tracts
 - Salmonella*
 - E. Coli*
 - Shigella*
 - Campylobacter jejuni*
- Viruses
- Parasites



What are Good Agricultural Practices (GAPs)?

- A “prevention” focused food safety management program
- The goal is to reduce food safety risks



Spinach and spring mix shelves sat empty Sept. 19 at a Mission, Kan., Wild Oats store. Boulder, Colo.-based Wild Oats Markets Inc. posted signs alerting customers to the absence of spinach.

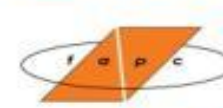
Losses could reach up to \$100 million

5 Step Plan

- 1st address pre-plant issues
- 2nd address production issues
- 3rd address harvest issues
- 4th address post-harvest issues
- 5th address record keeping issues



FAPC-168
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Developing a Food Safety Plan for Your Fresh Produce Operation

William McGlynn

FAPC Horticultural Products Processing Specialist

Lynn Brandenberger

Horticulture Food Crops Extension and Research Specialist

Introduction

The safety of fresh fruits and vegetables for direct consumption is an important issue for both consumers and producers. During the past few decades, consumption of fresh produce has increased substantially as people have learned more about the health benefits of a diet rich in fresh fruits and vegetables. Along with the increased consumption of fresh produce, there has been an increase in foodborne disease outbreaks associated with fresh produce. Both consumers and producers suffer adversely when fresh produce related outbreaks occur. Consumers suffer serious health risks, and the produce industry suffers from a loss in consumer confidence and trust and the resultant loss in sales. Aside from losses in human productivity and potential caused by illness and even death, an outbreak can result in the loss of millions of dollars from lost sales and lawsuits.

In fact, the Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables¹ states "current technologies cannot eliminate all potential food safety hazards associated with fresh produce that will be eaten raw." Times during which producers should be vigilant to reduce and control food safety risks include prior to planting, during the planning stage, during production, and during and after harvest. Before planting, growers should complete a grower risk assessment. Cornell University has a great publication to help with this titled "Food Safety Begins on the Farm – A Grower Self Assessment of Food Safety Risks"². The document includes 24 sections that provide GAPs and checklists for everything from worker hygiene to petting zoos. Working through the assessment will help producers in developing a food safety plan for their operation.

GAPs

Good Agricultural Practices (GAPs) are an important concept for producers of fresh fruits and vegetables to understand in order to assure the microbial safety of produce that is grown in their operation. GAPs involve many things, but essentially they are practices used during planning, production, harvest and after harvest to guard the safety of fresh produce. However, there is not a one-size-fits-all plan for food safety. GAPs must be uniquely tailored to crops and management practices for each farm. Basically, we need to focus on reducing the risk of contaminating fresh produce. It is not possible at this time to completely eliminate food safety risks;

GMPs

Good Manufacturing Practices (GMPs) pick up where GAPs leave off. GMPs cover issues such as sanitary design of the packing shed itself and any produce-handling equipment or produce contact surfaces, packing shed pest control, packing shed sanitation, worker health and hygiene monitoring, and temperature control for produce that requires refrigeration. Sanitizing washes or dips, which rely on chlorine or other sanitizers to kill harmful microbes, also may be part of a GMP program. The overall goal of a GMP program is to minimize and control the risks of contamination that occur after harvest and during packing and includes many of the same principles that are applied as part of a GAPs program.

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Tools for Keeping Track

- FAPC 167
 - Fresh Produce Production Food Safety Plan Logs and Worksheets
 - Worksheets include:
 - Worker training
 - Site selection
 - Cleaning logs
 - Water treatment logs
 - Pest control logs
 - Cooler temp. log
 - Truck check list
 - Illness/injury log
 - Fertilizer/compost/manure
 - Trace back/recall logs

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Fresh Produce Production Food Safety Plan Logs and Worksheets

William McGlynn
FAPC Horticultural Products Processing Specialist

The following worksheets are intended to serve as templates to cover most of the documentation and record keeping that will occur as part of a typical fresh produce food safety program. Not every size and type of operation will need to use every sheet, but most operations will want to capture and record most of the information these sheets are designed to document. It is expected these sheets will serve as a foundation and inspiration for further customization. For example, some operations may find it beneficial to create separate log sheets to document the cleaning and sanitation of different types of equipment or different areas within a packing facility. Separate log sheets for different washing or sanitizing tanks may be useful as well. Don't be afraid to experiment to find out what works best for your operation.

Proper record keeping protocols:

- **Always fill in information in real time.** Never fill in information after the fact. When things are busy, it is always tempting to wait to record information after performing an inspection or a test. This is a good way to introduce errors into one's documentation and sends up a red flag to third-party auditors.
- **Never falsify information.** The temptation is obvious, but the fact is inspectors and auditors will almost certainly be much more concerned about falsified information or test results than about missing data.
- **If an error is made in entering information, do not erase or obscure it.** The proper protocol to correct a mistake is to put a single line through the erroneous entry, write in the correct information and initial the change. If for some reason the correction occurs some period of time after the information is originally entered, make a note of the time/date of the correction and the reason for the delayed correction on the page. Remember: **Record it or regret it!**

Lynn Brandenberger
Horticulture Food Crops Extension and Research Specialist

Acknowledgement: These worksheets were adapted from documents originally developed by Robert B. Gravani, Ph.D., Elizabeth A. Bihn, M.S., and others at the Cornell University Department of Food Science.

A Note on Calibration of Your Thermometer¹
(See worksheet on page 11)

Melting point of ice method (requires a thermometer that may be calibrated by adjusting a movable back plate on which temperature gradations appear):

1. Place ice in a container and let it melt.
2. Stir to make sure the temperature in the ice/water mixture is uniform throughout the container.
3. When the ice is partially melted and the container is filled with a 50/50 ice and water solution, insert the thermometer and wait until the needle indicator stabilizes. The thermometer should be 32°F (0°C).
4. If the thermometer is not reading 32°F (0°C), it should be adjusted by holding the head of the thermometer firmly and using a small wrench to turn the calibration (hex) nut under the head until the indicator reads 32° (0°C).

An important item to remember as you are calibrating your thermometer using the melting point of ice method is to never add water to ice to create an ice/water mixture because this mixture will not stabilize at 32°F (0°C) for some time, but will instead be at higher temperatures. The calibration will be much more accurate if you allow ice to melt to create an ice/water mixture.

¹This thermometer calibration information is taken from "Food Store Sanitation," 1998, Sixth Edition, Gravani, Robert B., Rishoi, Don C., Cornell University Food Industry Management Distance Education Program, Lebar-Friedman Books, Chain Store Publishing Corp.

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GAPs before planting: Site Selection

- Site selection :
 - Know your land history
 - Upstream-downstream
 - Upwind-downwind
 - environmental management plan



Site Selection Review

Name of operation:

Please see the food safety plan for site selection procedures.

Previous Land Use (animal, crop production, industrial, dump for industrial, animal, sludge or biosolids)	Potential for Livestock and Wildlife Contamination	Potential for Wind Borne Contaminants	Potential for Surface Water Contaminants	Test Results*	Initials

* Attach any testing lab results.

Reviewed by:

Title:

Date:

16/23

GAPs before planting: Evaluate Water Sources

- Agricultural water sources carry different levels of risk:
 - Surface water (high)
 - Impoundments (high)
 - Ground water (medium)
 - Municipal water supplies (low)



Irrigation / Spray Water Treatment Log

Name of operation:
Please see the food safety plan for irrigation / spray water testing procedures and time intervals.

Water Source (surface, well, etc.)	Test Date	Test Results*	Corrective Actions Taken (if necessary)	Initials

* Attach testing lab results.

Reviewed by:

Title:

Date:

GAPs before planting:

Crop Selection

- Crop selection
 - Roots below soil surface
 - Leafy on soil surface
 - Fruit above soil surface



GAPs before planting: Manure Management

- BMPs “Best Management Practices”
 - Manure management
 - Storage
 - Incorporation
 - Time of application
 - 120 days prior to harvest of any vegetable crops
 - Keep good records



Fertilizer / Compost / Manure Applications log

Name of operation: _____

Please see the food safety plan for overall manure application procedures

Date	Field Location	Material applied	Rate (ton/acre)	Composted? (Y / N)	Incorporated? (Y / N)	Supplier	Date Crop Planted	Date Crop Harvested	Initials

167-015

Reviewed By: _____ Title: _____ Date: _____

Gap's before planting: Compost Management

- Manure or compost supplier
- Or analyze compost or manure
- Composting process
- Application records
 - Source of compost/manure
 - When
 - Where



GAPs during production: Water Management

- Know the water source & intended use
- Evaluate your irrigation methods
- Be active in local watershed groups
- Test water quarterly
 - Fecal coliforms
 - Keep good records



- Water for spraying
 - BMP: Use potable (drinking) water for pesticide sprays



GAPs during production: Worker Hygiene

- Farm workers handle produce during production-harvest-after harvest
- Teach workers about food safety
 - Effective training results in better employees and safer produce
- Provide clean restrooms with soap, water, and single-use towels and enforce use of facilities



Worker Training Log	
Name of operation: _____	Date: _____
Trainer: _____	Training Time: _____
Location: _____	
Subject of training session: _____	
Training method: <input type="checkbox"/> Video <input type="checkbox"/> Lecture <input type="checkbox"/> Handout (Check all that apply)	
(Please attach any written materials to this log with a staple):	
Please see the food safety plan for overall Worker Training procedures.	
Employee Name (please print)	Employee Signature
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____

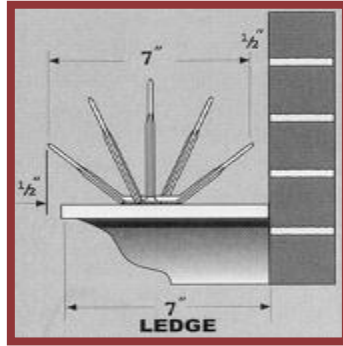
GAPs during production:

Fertilizer Sources

- Fertilizer types
 - Organic
 - Synthetics



GAPs during & after production: Excluding Animals



Exclusion

Baiting



traps.com/endtunnel.htm

Sanitation

L. LaBorde, Penn State

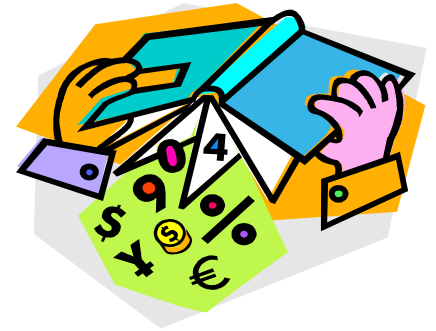
Trapping

Documentation is Essential!

- **Cleaning & sanitizing procedures & schedule**
- **Type & strength of sanitizing solutions**
- **Record when sanitizing solutions are made & tested**

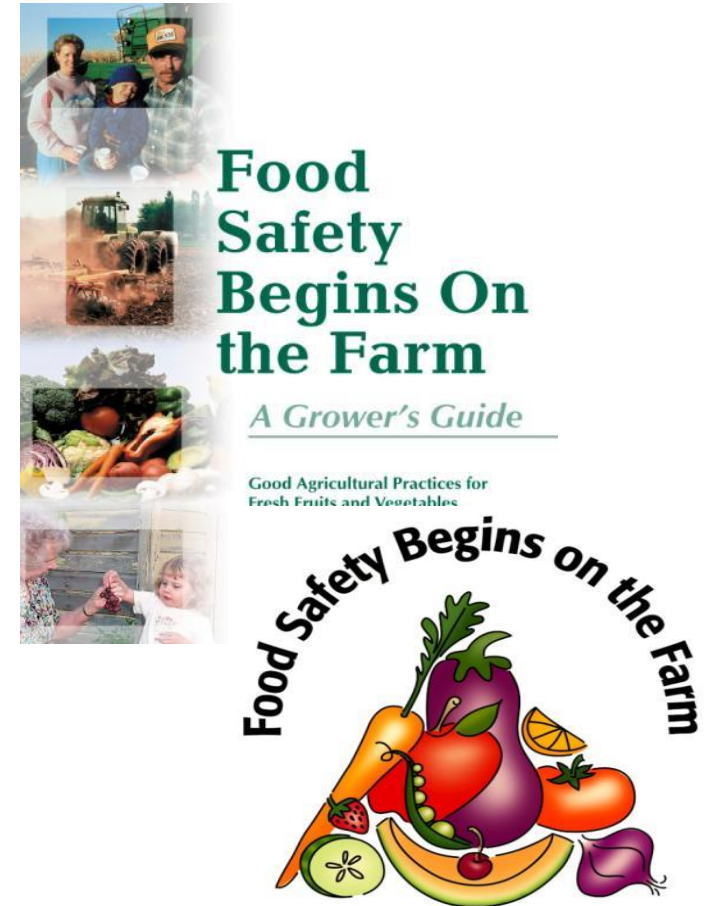
Record It or Regret It !

- **Description of pest control program**
- **Date, time, and results of pest control inspections**
- **Corrective actions taken**



Produce Safety Alliance Training Program

- What's happening
 - Program title: “Produce Safety on Farm Preventive Controls Training”
 - Led by Produce Safety Alliance & FDA
 - Curriculum in final stages
 - Standard GAPs training program for U.S.
 - Train the trainers will begin training in spring 2015
 - Hope to have available for growers
 - Sometime during 2015



GAPs during harvest: issues

- Worker hygiene
- Equipment cleaning / sanitation
- Avoid damaging produce
- Holding/transport equipment cleaning



GAPs during harvest: considerations

- Use clean harvest containers
- Ideally pick produce when it's dry
- If it has droppings on it leave it!
- Leave fruit that is bruised or cut
- Cool product quickly



GAPs during harvest:

Worker Hygiene

- Farm workers & U-Pickers are often the last people to handle produce
- Teach about food safety
 - Effective training is a must
- Provide clean restrooms with soap, water, and single-use towels and enforce use of facilities
- Encourage good hygiene
 - Good signage



GAPs during harvest: sanitation

- Develop a cleaning and maintenance schedule for equipment
 - Assign to reliable workers
- Clean and sanitize storage facilities prior to harvest
- Clean and sanitize harvest bins, machinery, knives etc. daily or as practical
- Avoid standing in harvest bins
- Don't haul fresh produce in contaminated or dirty bins



GAPs after harvest: issues

- Cooling or wash water sanitation
- Cooling water temperature
- Strength of sanitizing washes
- Proper storage & transport



Using bleach as a surface sanitizer: safety and effectiveness

- Chlorine is highly corrosive and produces dangerous fumes
 - ✓ Adequate ventilation a must
 - ✓ pH 6.5-7.5: ≤ 5.0 = Chlorine gas
 - ✓ ≥ 8.0 = loses effectiveness
- Chlorine solutions lose killing power over time
 - ✓ Chlorine strength should be monitored
 - ✓ Fresh chlorine solution should be made at least daily and perhaps more often



Using bleach as a sanitizer: washing produce

- General sanitizer solution: ~ 200 PPM Chlorine

- (1 tablespoon bleach / gallon water)

- Apples, pears, squash, cucumbers: ~ 65 PPM chlorine

- (1 teaspoon bleach / gallon water)

- Leafy greens, peaches, peppers, tomatoes, asparagus, broccoli, carrots: ~ 130 PPM chlorine

- (2 teaspoons bleach / gallon water)

- Melons, citrus, root crops: ~ 400 PPM Chlorine

- (2 tablespoons bleach / gallon water)

- Berries (strawberries, blueberries, blackberries, raspberries, etc.):

- No Washing



Wash/cooling water temperature

- If produce is much warmer than wash water, produce may imbibe water during washing
- Keep wash water at least 10°C (18°F) warmer than produce during washing
- Proper sanitizing of wash water is critical!



Things to do once a day

- Inspect handling/packing areas and remove any dirt, debris, or culls
- Clean and sanitize:
 - ✓ Handling/packing areas and equipment
 - ✓ Floors
 - ✓ Drains
 - ✓ Waste receptacles
 - ✓ Bathrooms



A large warehouse or packing facility for fruit. In the foreground, there are large piles of yellow fruit, likely lemons or grapefruit. A worker in a blue shirt and white apron is crouching down, sorting through the fruit. In the background, there are yellow metal racks filled with yellow crates. Some crates have labels like "Sucamore" and "EYDEWS". The warehouse has a high ceiling with metal beams and large windows. A fan is visible in the background.

**Think of all facility surfaces
as possible food contact surfaces**

Proper Storage of Packed Produce

- Proper storage a must!
 - ✓ Away from potential hazards
 - ✓ Monitor cold room



Transportation is Key for Food Safety

- Transport trucks must be clean
 - ✓ Inspect prior to loading
 - ✓ Clean & sanitize prior to loading



Traceback and positive lot identification

- Essential part of any food safety program – part of new FSMA regulations
- May be required for country of origin labeling
- Container coding is mandatory for some processed products

Recall / Traceback Log

Name of operation: _____ Date: _____

Conducted by: _____ Lot: _____

Product traced: _____

Please see the food safety plan for overall traceback procedures.

Step backward					Step forward		
Harvest date	Harvester	Packing date	Packer	Shipping date	Customer(s) contacted	Amount of product remaining from original shipment at customer	Disposition of product which could not be recalled

Reviewed by: _____ Title: _____ Date: _____

157-17



You May want to consider 3rd – party audits

- May be useful in opening new markets
- Often customer driven
- Most auditors offer various levels of auditing
- Assistance tools are usually available



Acknowledgements

- ✓ W. McGlynn, E.A. Bihn, T. Bowser, L. Brandenberger, J. Young, P. Brady, D. Granberry, A. Rangarajan, T.V. Suslow, R.B. Gravani, M.P. Pritts & R. Worobo.
- ✓ <http://www.extension.org/faq/27561/print/>
- ✓ <http://www.foodsafety.gov/~dms/prodguid.html#iii>
- ✓ http://img.dailymail.co.uk/i/pix/2007/03_02/sheep240307_486x386.jpg
- ✓ <http://www.soils.wisc.edu/~barak/soilscience326/periodic.gif>
- ✓ http://www.gardengrowth.com/wp-content/uploads/image/compost/compost_piles.jpg
- ✓ <http://blog.oregonlive.com/pdxgreen/2008/01/compost.jpg>

References

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 - Food Safety.gov:
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<http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm415031.htm>
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 - CDC information on outbreak from:
 - <http://www.cdc.gov/listeria/outbreaks/cantaloupes-jensen-farms/120811/index.html>

