the Southern Region small fruit consortium

Postharvest Handling of Small Fruits, SRSFC Sponsored County Agent Training

June 25-27, 2012, NC Research Campus, Kannapolis, North Carolina

Table of Contents

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POSTHARVEST HANDLING

OF

SMALL FRUITS

SRSFC SPONSORED COUNTY AGENT TRAINING

June 25-27, 2012

NC Research Campus

Kannapolis, North Carolina

SRSFC Sponsored Postharvest Training in Small Fruits

June 25-27, 2012

Kannapolis, NC

Dr. Penelope Perkins-Veazie/ Dr. Gina Fernandez

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704.250.5419/ 919.513.7416

Professor, NCSU, postharvest physiology /Professor, NCSU, extension and breeding, caneberries

Objectives:

Learn how to address basic postharvest questions and issues for small to large producers of small fruits

Learn the similarities and differences in small fruits for quality aspects, postharvest handling

Use a simple system of tools and cooling to rapidly assess grower problems and develop low cost solutions to these problems

June 25 Monday: Travel to Holiday Inn, Kannapolis, NC (about 40 min North from Charlotte airport)

June 26 Tuesday: Travel from Holiday Inn, Kannapolis to the NC Research Campus (about 3 miles)

1. Welcome and overview of objectives 8:15 am
2. "Postharvest handling of small fruits" (Penelope Perkins-Veazie) 8:30-9:30 am
3. "Food safety, GAPS, FSMA: Coping with new regulations for fresh produce" (Diane Ducharme) 9:30-10:30 am
   Break
4. "Postharvest diseases of small fruits" (Bill Cline) 10:45-11:45 am
5. View cool bot (refrigerated portable system); portable hand wash station
6. Lunch (catered) 12:15 -1:15 pm
   Walk to NCSU building 1:15-1:30 pm
7. Do hands on work in lab to learn how to do field screening and postharvest troubleshooting, tour facility
   1:30-2:30 pm
8. Travel to NCDA Piedmont research station by bus 2:30-3:00 pm
   (1000 acre research farm, incorporating poultry, dairy, and horticulture research; horticulture includes Muscadine and blueberry vineyards, strawberry breeding plots and tunnel systems, raspberry and blackberry selection trials, seedling fields, trellis systems.

9. Look at on farm equipment, tour fields (trellis system, cooling units etc) 3-5 pm

-start with field aspects, such as trellising of blackberries for better quality and reduced heat load
-using the postharvest tool kit, try measuring infra red temperatures of plants and fruit in shade and sun
-walk through blackberries and blueberries, harvest samples to become acquainted with differences in firmness, size, stemming, sunburn, disease, insects (common postharvest problems in packs).
-go to the pack area and see how a refrigerated system can be constructed cheaply and run efficiently as a walk in or trailer (portable) model
-learn how to do forced air cooling using a box fan, tarp, and fruit

10. Barbeque chicken/pork dinner 5:15-6:30 pm

Return to hotel

June 27 Wednesday

Check out, board bus for field tour	8:00 am
Tour by charter bus to Ervin Lineberger's small fruit operation (blackberry, muscadine)	9:00-10:00 am
Lincolnton-Dole blackberry fields, in field grading system, and large distribution center	10:30-11:00 am
Return to hotel	11 am-12 pm

POSTHARVEST HANDLING OF SMALL FRUITS

PENELOPE PERKINS-VEAZIE
PROFESSOR
PHHI, NCSU, NCRC, KANNAPOLIS
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SFRC
TRAINING
2012

POSTHARVEST: GENERAL

- POSTHARVEST=FIELD TO FORK
- BUT PRE HARVEST DECISIONS OFTEN AFFECT POSTHARVEST LIFE

OBJECTIVES OF TRAINING

- BASIC PHYSIOLOGY
- SHELF LIFE EXTENSION
- FOOD SAFETY
- PLANT PATHOLOGY-POSTHARVEST FUNGI
- LAB AND FIELD TO COVER HOW TO JUDGE SHELF LIFE INDICATORS, HOW SYSTEMS FOR POSTHARVEST WORK

SMALL FRUITS

- SHRUB, VINE, PLANTS
- BLUEBERRY, RASPBERRY, BLACKBERRY, GRAPES, STRAWBERRY
- ARTIC KIWI, AUTUMN OLIVE, AHRONIA, BLUE HONEYSUCKLE, ELDERBERRY

SMALL FRUIT CHALLENGES

- MOST SMALL FRUITS WON'T CONTINUE TO RIPEN NORMALLY ONCE DETACHED
- WILL GET COLOR GAIN BUT NOT NORMAL TEXTURE CHANGES
- MOST HAVE TO BE PICKED NEAR FULL RIPENESS

DIFFERENCES FROM OTHER CROPS

- MUST BE ALMOST TO FULLY RIPE
- MUST PICK INTO FINAL CONTAINER
- NO WASHING
- RAPID COOLING AND COLD CHAIN CRITICAL
- NO MECHANICAL SORTING
- CONSUMERS EAT WITHOUT WASHING

CAUSES OF LOSS IN SMALL FRUITS

1. WATER AND WEIGHT LOSS (TURGOR, PACK WEIGHT)
2. BRUISING/CUTS
3. MOLD/DECAY
4. COLOR CHANGE AND DARKENING
5. LEAKAGE OF JUICE
6. SEPAL WILT (STRAWBERRY)

SMALL FRUIT QUALITY

- GLOSS/BLOOM
- FULL COLOR, USUALLY DARKER
- NO DECAY, INJURY, BRUISE
- FIRM, CRISP
- LARGER SIZE
- SWEET
- GREEN SEPALS (STRAWBERRY)
- NO STEMS (BLUEBERRY)

GAP (GOOD AGRICULTURAL PRACTICES)

- POTABLE IRRIGATION WATER
- ANIMAL EXCLUSION FROM FIELDS
- WORKER HYGIENE
- ANIMAL EXCLUSION FROM SHED
- CLEAN CONTAINERS AND EQUIPMENT
- ADEQUATE COOLING AND REFRIGERATION

PREVENT BACTERIA, MOLD, YEAST, FOODBORNE ILLNESSES

STEPS FOR QUALITY

PREHARVEST

- VARIETY SELECTION
- HARVEST/HANDLING SYSTEM
- FOOD SAFETY HAZARDS
- CONTAINER

FIRST STEP IN POSTHARVEST LIFE:

VARIETY SELECTION

PRODUCTION ENVIRONMENT: HEAT, RAIN, COLD

FIRMNESS: GET IT OFF THE PLANT WITHOUT LEAKING

SHAPE AND SIZE: ROUND/LONG, LARGE /SMALL (WHAT FITS YOUR PACKAGE AND MARKET?)

SHELF LIFE: DECAY RESISTANCE, TRANSPORT RESISTANCE

OTHER DEFECTS: SUNBURN, RED DRUPE, STEMMING, WHITE TIP

PRODUCTION ENVIRONMENT

- **RIPENING, SOFTENING ACCELERATED WITH WARM TEMPERATURES**
- **NOT ALL VARIETIES WORK IN ALL PLACES: CHECK FOR RECOMMENDED VARIETIES FOR THE AREA**

WHAT IS YOUR MARKET?

U-PICK: SIZE, FLAVOR SELL

LOCAL: IN A 100 MILE RADIUS- WANT FULLY RIPE

LONG

DISTANCE: ¾ RIPE, FIRM, NO INJURY

SPECIALTY: VARIETAL RECOGNITION, SIZE

STRAWBERRIES

- ALBION
- CAMAROSA
- CHANDLER
- SWEET CHARLIE
- GALLETA
- FESTIVAL:MAY WORK UNDER TUNNELS
- SEASCAPE: SOFT IN WARM ENVT

BLUEBERRIES

- NORTHERN (DUKE, BLUECROP)
- SOUTHERN-CAN BE EARLY OR LATE; BLOOMS MAY GET FROSTED
- RABBITEYE-LATEST, LONGEST SHELF LIFE, LEAST WINTER HARDY

BLACKBERRY

NATIONAL SHIPPING

NAVAHO

NATCHEZ

APACHE

ARAPAHO

OUCHITA

PRIME-ARK 45 (THORNY ERECT)

CHESTER THORNLESS (SEMI ERECT)

TUPY (THORNY TRAILING)

RASPBERRIES

PRIMOCANE:

- **AUTUMN BRITTEN, A. BLISS**
- **NANTAHALA**
- **HERITAGE (SMALL WITH HEAT)**

FLORICANE:

- **TULAMEEN**
- **HIMBO TOP**
- **LAUREN**
- **OCTAVIA**

RASPBERRY RESPONSE MUCH HARDER TO PREDICT

WHAT AFFECTS SHELF LIFE?

POSTHARVEST

- HARVEST SYSTEM
- CONTAINER
- RATE OF COOLING
- STORAGE TEMPERATURE
- RELATIVE HUMIDITY
- TRANSIT TEMPERATURE

CONTAINERS

- PLASTIC CLAMSHELL
- ½ PINT, PINT, 12 AND 18 OZ (NO MORE THAN 3 LAYERS)
- VENTED ON TOP AND SIDES; HAVE LID!!
- UPICK/FARMERS: QUART

AND LARGER

- PULP BOXES
- WOOD SPLINT BOXES

CONTAINER

STACKABLE

2 LB BASKET FOR LOCAL ONLY

CLAMSHELL WITH ROUND HOLES

CLAMSHELL WITH SLITS

1 GALL BUCKET-BLUEBERRY, STRAWBERRY

MASTER FLATS OR CARTONS

TOP
FLAT
GUARD

REINFORCED CORNERS
SIDES STACK VERTICALLY
FORCED AIR VENTS
HOLD 12 CLAMSHELLS

MASTER
WITH AIR
VENTS

PREHARVEST: FOOD SAFETY HAZARD POINTS:

BEFORE HARVEST: FERTILIZER, DUST, IRRIGATION WATER

DURING HARVEST: HYGINE, WORKER HEALTH, SOIL CONTACT, WORKER TRAINING

AFTER HARVEST: TRANSPORT CLEANLINESS, COOLER CLEANLINESS

SANITATION: CONSUMERS DON'T ALWAYS WASH FRUIT!

PROVIDE WASH STATION AS WELL AS TOILET FACILITIES

PICK FULL COLOR, FIRM, EASILY DETACHED

BE GENTLE!

HARVEST

- AVOID PICKING IN HEAT, ESPECIALLY LATE AFTERNOON

(FRUIT ARE SOFTER, HAVE MORE HEAT LOAD)

- DON'T PICK WHEN WET. IF HEAVY DEW, USE AIRBLAST SPRAYER (NO SPRAY) TO BLOW DRY ON PLANTS

MOLDS/FUNGAL

PICK EVERY 2-3 DAYS TO AVOID OVERRIPE AND DECAYED FRUIT

PICK OFF OVERRIPE/ DECAYED FRUIT AND DISCARD

BOTRYTIS-GRAY MOLD

ANTHRACNOSE (SALMON COLORED)

INJURY

PREHARVEST

SUNBURN

AVOID THESE FRUIT WHEN PICKING

POSTHARVEST

HEAT/BRUISE

IMMATURE

DON'T OVERFILL

RAIN DAMAGE

PACKING SYSTEM 1

PICK INTO CLAMSHELL

PLACE CLAMSHELLS IN TOMATO BOX

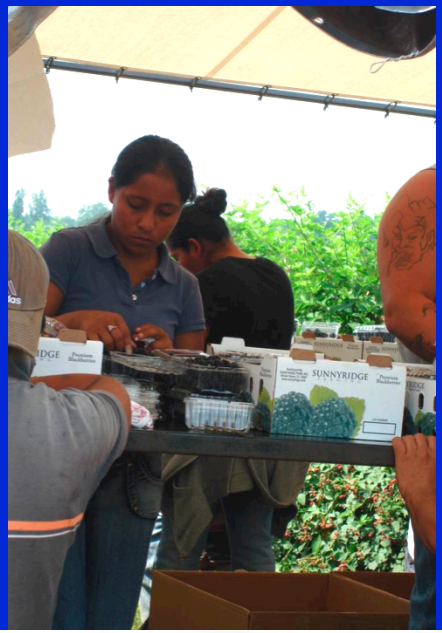
TRANSPORT TO SHED

CHECK/REPACK FRUIT IN CLAMSHELLS

PLACE IN MASTERS AND PUT IN COLD ROOM

PACKING SYSTEM 2
FIELD ONLY

PICK INTO CLAMSHELLS
BRING TO FIELD
PACKHOUSE
SORT FOR LEAK,
DAMAGE
PLACE INTO REEFER



COOLING SMALL FRUITS

- ROOM AND FORCED AIR COOLING SYSTEMS (RASPBERRY, STRAWBERRY, BLACKBERRY).
- BELT GRADING AND WASH: MUSCADINE, BLUEBERRY
- DELAYS DECAY
- REDUCES RESPIRATION/WEIGHT LOSS

STORAGE LIFE FOR SMALL FRUITS AT 32-34F

FRUIT	DAYS
RASPBERRY	10-14
BLACKBERRY	14-24
STRAWBERRY	14-28
BLUEBERRY	21-40
MUSCADINE	14-30

TEMPERATURE AND SHELFLIFE

TEMPERATURE	DAYS SHELF LIFE	
	BLACKBERRY	RASPBERRY
32 F	14-20	7-10
41 F	5-7	3-5
68 F	1-2	<1

IF DELAY COOLING: AFTER 2 H WILL LOSE 20% PER HOUR DELAY

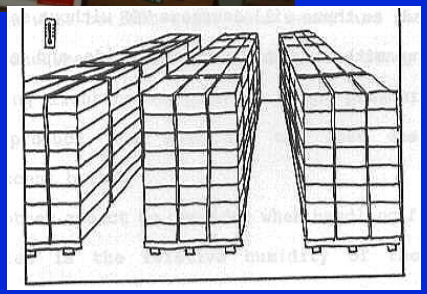
DIRECT MARKET/FARMERS MARKET

- IF SMALL VOLUMES: USE ICE CHESTS TO HOLD FRUIT NOT ON DISPLAY
- PRECHILL ICE CHEST
- USE GEL ICE WRAPPED IN PAPER TOWELS OR NEWSPAPER TO KEEP FROM MELTING
- DON'T ALLOW DIRECT CONTACT OF ICE OR WATER WITH FRUIT

COLD ROOMS

- **RAILWAY CARS/SHIP CONTAINERS+ ELECTRIC MOTOR + DIESEL GENERATOR**
- **SELF-CONSTRUCTED**
- **USED RESTAURANT COLD/FREEZER ROOMS**
- **OFTEN FA IS INSIDE A LARGER COLD ROOM**
- **CONVERT AC UNIT TO COOLING (COOL-BOT)** http://www.storeitcold.com/

ROOM COOLING:
ALLOW AIR MOVEMENT BETWEEN BOXES AND FLATS

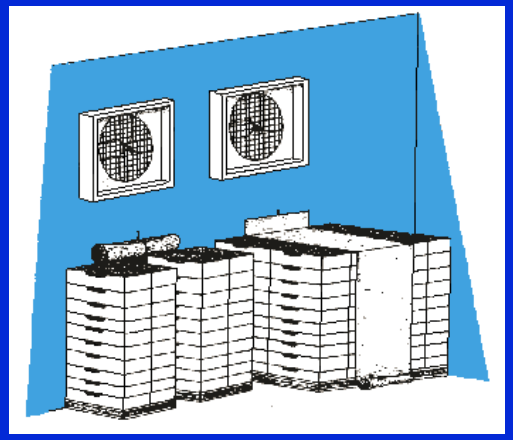


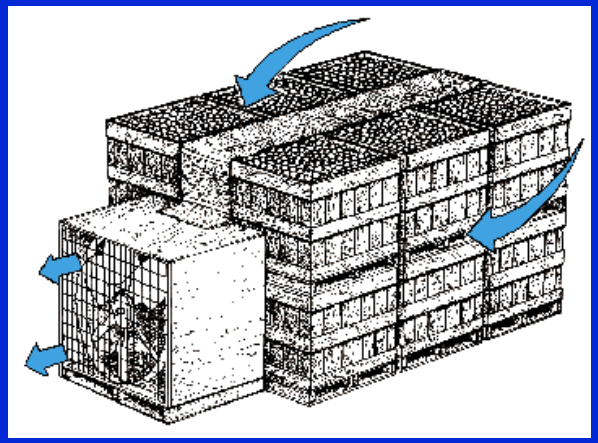
VENTS IN MASTER FOR AIR FLOW WITHIN CARTON

FORCED-AIR COOLING (TUNNEL)

PULLS COLD AIR THROUGH DIRECTED PATHS IN BOXED FRUIT

- CAN BE FIELD PORTABLE
- ROOM PORTABLE
- BUILT-IN





STORAGE AFTER COOLING

- **KEEP NEAR 32 F**
- **KEEP RELATIVE HUMIDITY >90%**
- **HOLD NO MORE THAN 2 DAYS ON SITE**

AVOIDING WEAK LINKS IN THE COLD CHAIN

1. COOL AS QUICKLY AS POSSIBLE- MAKE SEVERAL SMALL TRIPS TO COOLER
2. KEEP PRODUCT COOLER IN FIELD-USE SHADE, ADD MIST SYSTEM (WHERE LOW HUMIDITY)
3. PAY ATTENTION TO AIR FLOW, STACKING, BOX VENTS

COLD CHAIN (CONT)

- **LOAD INTO REFRIGERATED TRANSIT AS QUICKLY AS POSSIBLE**
- **UNLOAD INTO REFRIGERATED STORAGE QUICKLY**
- **MEASURE/MONITOR TEMPERATURE AT EACH STEP AND DURING TRANSIT USING RECORDERS** (STOW AWAY)

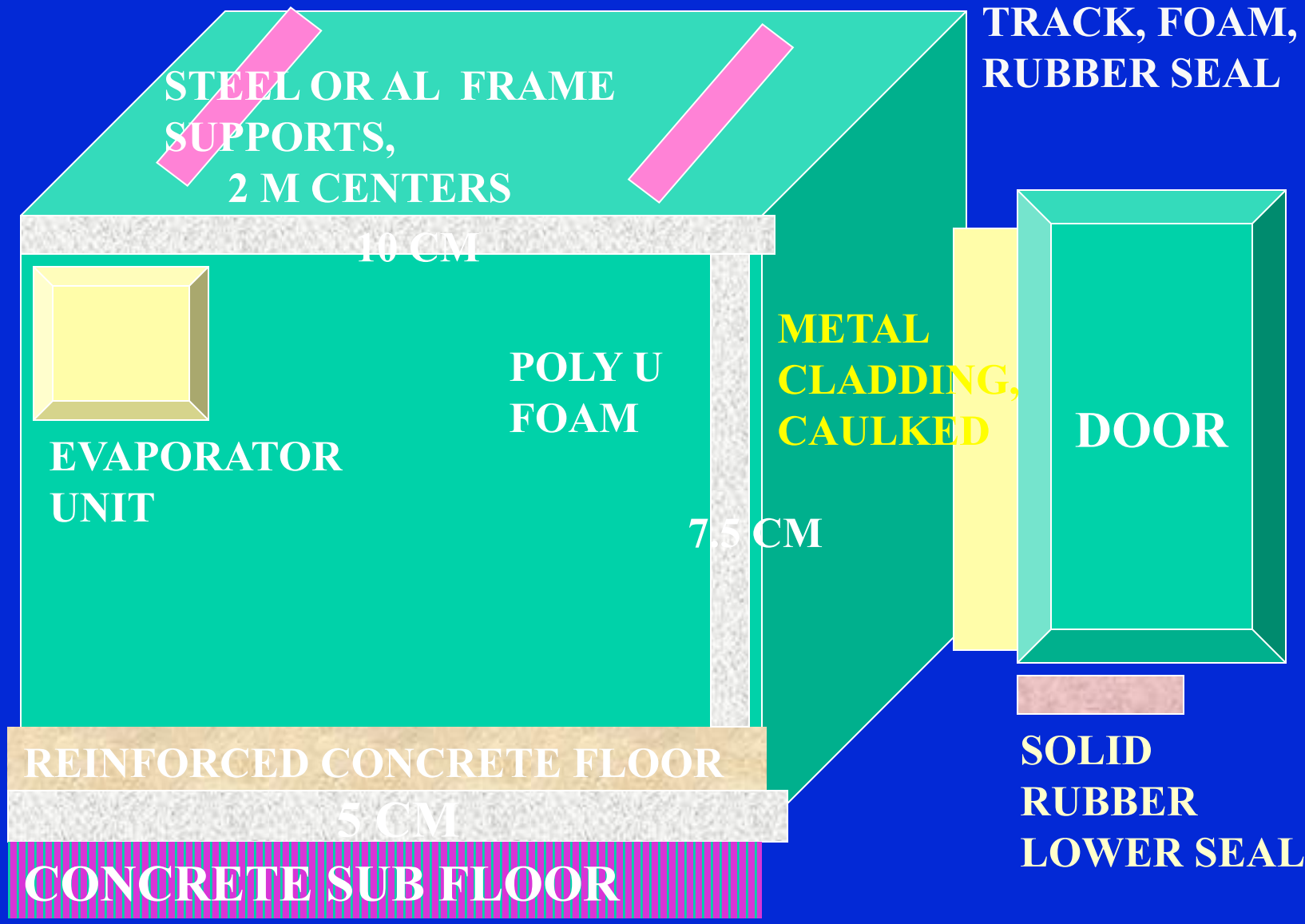
MA OR CA STORAGE

- USED DURING TRANSPORT (3-5 DAYS)
- EXCELLENT CONTROL OF GRAY MOLD
- KEEPS FRUIT IN 'SUSPENDED ANIMATION'
- USED FOR STRAWBERRY, BLACKBERRY, RASPBERRY, BLUEBERRY (WHEN SHIPPED BY CONTAINER-SHIP)

SELF-CONSTRUCTED COLD ROOM

- WOOD FRAME
- CONCRETE FLOOR
- INSULATE WITH FIBERGLASS BATTS
- INSTALL TIGHT VAPOR BARRIER ON WARM SIDE OF INSULATION (OUTSIDE)
- MECHANICAL REFRIGERATION SYSTEM/ ROOM AIR CONDITIONER

COOLING ROOM DIAGRAM



COOL BOT DEVICE ($300)
(http://www.storeitcold.com/)

USES REGULAR AC UNIT ($600) FOR LOW TEMPERATURE COOLING (10,000-25,000 btu)
FOOLS AC UNIT INTO RUNNING TEMPERATURE LOWER

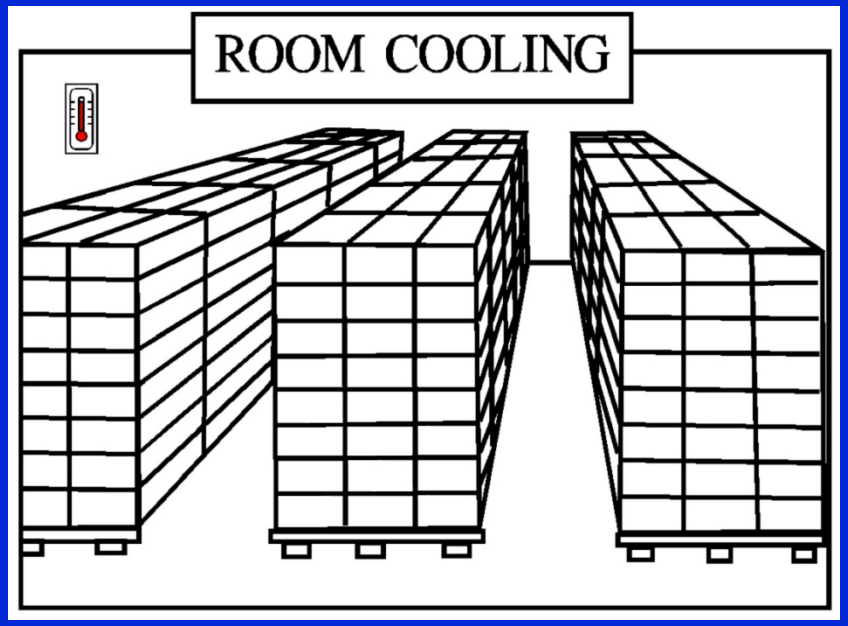
CHEAPER THAN USED COOLERS
EASY TO FIX-UNPLUG AND REPLACE IF A CRISIS
LOWER ENERGY USE

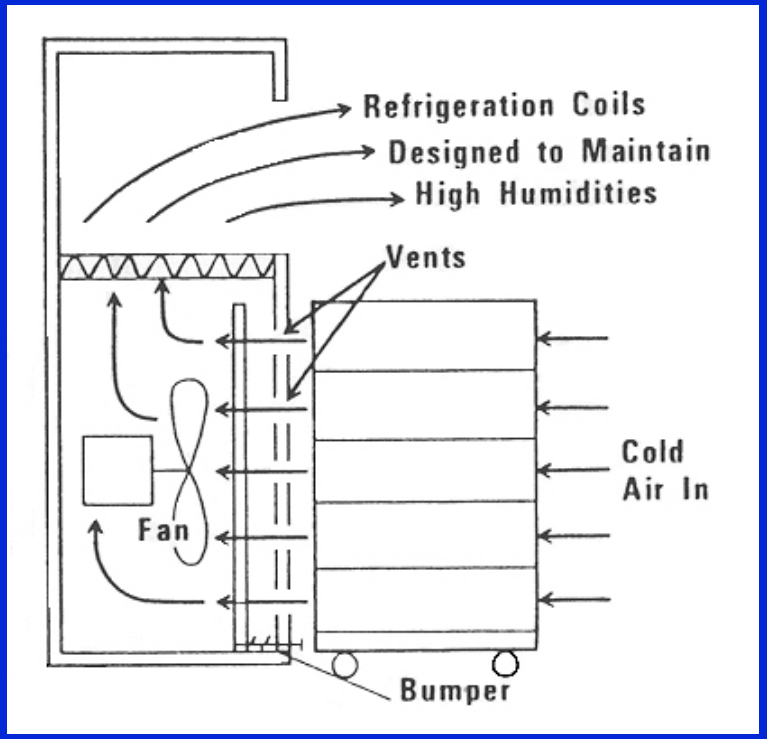
PRE COOLING

- ROOM COOLING

- FORCED AIR COOLING

ROOM COOLING SETUP





FORCED-AIR COOLING

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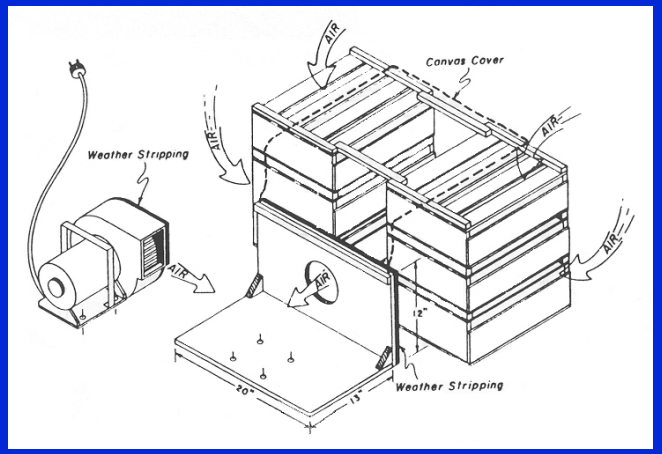


CURTAIN
FA FANS
8 11 '94

TRANSPORTATION AND HANDLING

- CLEAN AND WELL MAINTAINED TRUCKS
- REFRIGERATION WORKING
- TIME/TEMPERATURE RECORDERS IN PLACE

http://www.deltatrak.com

http://
www.coldice.com/
temperature_record
er_strip_chart.html

AVOIDING WEAK LINKS IN THE COLD CHAIN

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COLD CHAIN (CONT)

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- UNLOAD INTO REFRIGERATED STORAGE QUICKLY
- MEASURE/MONITOR TEMPERATURE AT EACH STEP USING RECORDERS

SUMMARY

- MAKE DECISIONS EARLY-VARIETY, FOOD SAFETY, MARKET CHOICES
- CONTROL HARVEST OPERATION

- REDUCE FIELD HEAT LOAD
- KEEP FRUIT COOL DURING STORAGE AND TRANSIT
- USE MA ONLY IF A PREMIUM PRICE

SOURCES OF INFORMATION

- **BRAMBLE PRODUCTION GUIDE (CORNELL UNIVERSITY)**
- **USDA HANDBOOK 66 http://www.ba.ars.usda.gov/hb66/**

- **NC BRAMBLE PORTAL**

http://www.ncsu.edu/enterprises/blackberries-raspberries

postharvest.ucdavis.edu/Pubs/publications.shtml

- **Postharvest Technology of Horticultural Crops publication 3311 (UC-davis) 2002**
- **Postharvest Technology for Small-Scale Produce Marketers: Economic Opportunities, Quality and Food Safety**

NC STATE UNIVERSITY

Food Safety, GAPs, FSMA: Coping with New Regulations for Fresh Produce

Diane Ducharme

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Plants for Human Health Institute

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NC State University
A&T State University
COOPERATIVE EXTENSION
Empowering People · Providing Solutions

topics

- NC's Model for Education
- Identifying Microbial Risks & Remediation Steps
- GAPs audit
- FSMA
- Resources

NC's Model

- NC Fresh Produce Safety Task Force
- Team Approach
- Tiered-educational initiative
  - Agent-delivery
  - Specialist-delivery

North Carolina Fresh Produce Safety Task Force

- Purpose: to minimizes food safety risks and enhances the economic competitiveness of North Carolina's fresh produce industry.
- Goal: To ensure that North Carolina has a competitive, vibrant and safe fresh produce industry supported through the research, teaching and outreach programs of N.C. State University, N.C. A&T State University, North Carolina Department of Agriculture and Consumer Services, Farm Bureau and industry groups.

Unique Partnership

- Individual Growers
- Fresh Produce Brokers/Distributors
- Commodity Groups- Carolina Farm Stewardship Assoc. and others
- N.C. State University
- N.C. A&T State University
- North Carolina Department of Agriculture and Consumer Services – Marketing and Food & Drug Divisions
- NC Farm Bureau
- Carolina Farm Stewardship Association
- United States Food and Drug Administration (FDA)

6 Working Groups

- Education
- Research
- Industry and Policy Relationships
- Networking and Communication
- Small Farms
- Management

Training Aids in the form of Team

Testing your KNOWLEDGE Pre & Post tests developed

- What are you coming in with?
- Use of real-time technology

Break out activities
Top Three Words for….

- “Produce Safety”
- Number off (1,2,3)
- Break into groups
- Present to group

Third-deadliest U.S. food outbreak was preventable, experts say

By **Scott Bronstein** and **Drew Griffin**, CNN Special Investigations Unit

updated 9:21 AM EDT, Thu May 3, 2012

http://www.cnn.com/2012/05/03/health/listeria-outbreak-investigation/index.html

Highlights of Accomplishments

- fresh produce safety tiered educational curriculum (Tier 1-3)
- communication toolkit for agents
- on-line curriculum participant tracking
- certificate of attendance issuance
- searchable database for grower's marketing tool
- social media tools (Website, Blog, news releases, interviews)
- growers tool kits
- fresh produce safety plan template
- risk and liability (2) extension information sheets
- impacts (1) and case studies (3) documents;
- direct market display risk checklist
- needs assessments from agents and growers
- videos including The Produce Lady, risk & liability, educational mock audits
- eight bilingual worker trainings videos (YouTube)

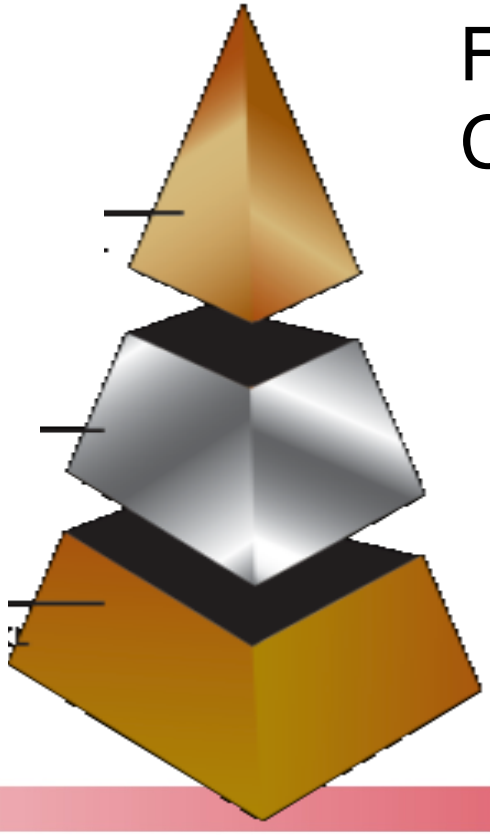
NC Fresh Produce Safety Initiative

NORTH CAROLINA FRESH PRODUCE SAFETY TASK FORCE
www.ncfreshproducesafety.org

Tier 3

Tier 2 - Traceability and Risk Mgmt

Tier 1- Basic Level



Farmers Market Curriculum

Small Farms Focus

Basic Training - Every Grower Should Know

- Module 1: Fresh Produce Safety Introduction
- Module 2: GAPs Field Practices
- Module 3: Packing Facility Sanitation
- Module 4: Health and Hygiene
- Module 5: Animals, Animal Byproducts, Biosolids &Site Selection
- Module 6: Water Quality

TIER 2

- **Module 7: The 3 Ts: Transportation, Traceback and Traceforward**
- **Module 8: Managing Liability and Risk**
- **Module 9: Dealing with Controversies and Crises: Working with News Media**
- **Case Study: Bagged Spinach Outbreak**
- **Validation Techniques (hands-on)**
- **SSOP, SOP, and food safety plan**

Food Safety Principles

Personnel Health & Hygiene

Sampling

GOOD FARMER'S MARKET PRACTICES

Food Safety Culture

Commodity-Specific Risks

Training program

Preparation, Storage, Sanitation

Eight Principles of Good Agricultural Practices

1. Prevent microbial contamination
2. Start program of GAPs
3. Human/animal feces
4. Water
5. Animal manure
6. Worker hygiene/sanitation
7. Follow all applicable laws
8. Traceback/recordkeeping/documentation

FDA: Transmission Routes for Microbial Contaminants in Fresh Produce

The four "W"s

1. Water
2. Worker
3. Waste
4. Wildlife

One year ago

- Food Safety Modernization Act signed into law by President Obama January 4
  - Phased-in implementation over next three years
  - Requires at least 12 new regulations from FDA

Courtesy of David Gombas, UF

FSMA One-Year Progress Report*

- Mandatory Recall Authority
- Administrative Detention of Foods
- Prior Notice of Imported Food
- Authority to Suspend the Registration of Food Facilities
- Fees (for certain domestic and foreign facility reinspections and for failure to comply with recall orders)
- Product Tracing Pilots Launched (tomatoes)
- Established the Produce Safety Alliance and the Food Safety Preventive Controls Alliance

*www.fda.gov/fsma

FSMA focuses on prevention

- Six major preventive control rules:
  - Food preventive controls (GMP modernization)
  - Feed preventive controls
  - Prevention of intentional contamination
  - Sanitary transportation
  - Foreign supplier verification
  - Produce safety

Courtesy of Donald W. Kraemer, Acting Deputy Director Center for Food Safety and Applied Nutrition, nFDA

Highlights of Two

Produce Safety Regulation

- Growing, harvesting, post-harvest handling of produce (e.g., trimming, washing, grading)
- Packing of produce, where exempt from BT Act registration

Food Preventive Controls Regulation

- Packing of produce, where subject to BT Act registration
- Processing of produce (e.g., fresh cut)
- Warehousing, shipping, receiving of produce

Courtesy of Donald W. Kraemer, Acting Deputy Director Center for Food Safety and Applied Nutrition, nFDA

Bioterrorism Act (Bt)- Registered Food Facilities

- Public Health Security and Bioterrorism Preparedness and Response Act of 2002, otherwise known as the **Bioterrorism Act**
- Both domestic and foreign farms do not need to register if they fall within the following criteria established by FDA:
  - Facilities that pack or hold food, provided that all food used in such activities is grown, raised or consumed on that farm or another farm under the same ownership.
  - Facilities that manufacture/process food, provided that all food used in such activities is consumed on that farm or another farm under the same ownership.
- By this definition, packing houses that pack foods other than those owned by them need to register. The Bioterrorism Act makes failure to register a prohibited act.

http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/RegistrationofFoodFacilities/default.htm

FDA U.S. Food and Drug Administration

Reportable Food Registry(RFR) for Industry

Effective September 2009

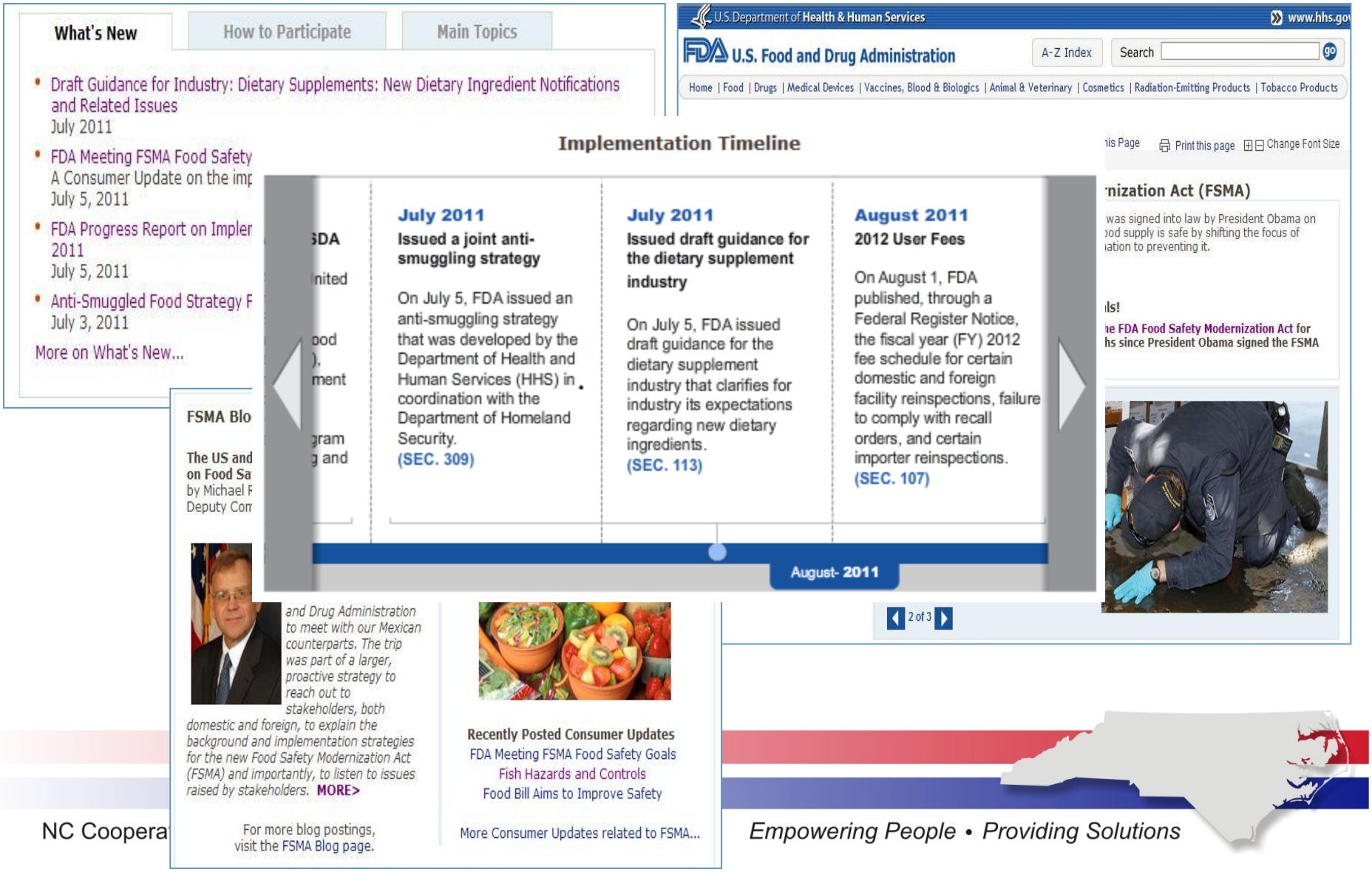
electronic portal to report when there is reasonable probability that an article of food will cause serious adverse health consequences.

Applies to registered food facilities that manufacture, process, pack, or hold food for human or animal consumption

Applies to all FDA-regulated categories of food and feed, except dietary supplements and infant formula.

http://www.fda.gov/food/foodsafety/foodsafetyprograms/rfr/default.htm#about

FSMA homepage http://www.fda.gov/fsma



Growing Market Demand for GAPs certification

- Market-driven, not required by law
  Food Safety Modernization Act (FSMA)
- Fresh Produce for schools- required
- Commodity-specific state/agreements- required
- Multiple Buyer requirements for different 3rd Party Auditors

GAPs Certification

- Annual Certification (365 days) with Passing Score
  - an unannounced surveillance review during year
- Costs
  - Certification, testing, equipment, change of process, additional facilities/equipment, etc.
- 3rd Party Auditors has to see the entire scope of activities "in operation" in order to audit (e.g production/harvesting activities)
  - Assess, manage, and demonstrate risk reduction

GAPs Certification Process

- Education
- Integrated policies and procedures into a food safety program/plan
- Train management &employees
- Decide on 3rd Party Auditor/checklist
- Schedule Audit

Education

- Risk Assessment
  - Self Certification – no cost way of going through the process of food safety on the farm to identify priority risk areas
- Understand your Market requirements
- Training to all staff, management – risks and understand reasons why
- Auditor Questions/ Matrix

3rd Party Auditors

An independent, impartial party hired to perform surveillance audits (ALL GENERAL EXCEPT AS NOTED)

- NSF Davis Fresh
- Primus
- Scientific Certification Systems (SCS)
- USDA
- Florida Dept. of Agric & CS (Tomatoes)
- Calif. Dept of Food & Drug/Leafy Green Marketing Agreement (CDFA/LGMA)
- Canadian Hort. Council (CHC)/ On-Farm Food Safety (OFFS)
- Georgia GAP

Choose Auditor

- Consider all Market requirements
  - Each market may have different needs in an audit
  - Audit may be commodity specific
- Can you combine Market needs by adding writers to one audit to accomplish all market needs?
  - Example: GA GAPs and Primus Audit

3rd Party Auditors Matrix

- Decide what part of the audit you will be doing
  - Field, Operation & Harvesting (Orchard)
  - Packhouse
- Download the checklists and expectation Manual
  - Includes actual questions
  - Understand the requirements from the questions from expectation
  - ASK QUESTIONS
- Understand Payment regime for Auditor
  - Hourly or part of audit
  - Travel expenses

General Questions

Implementation of a Food Safety Program

	Questions	Points	Yes	NO	N/A	Doc
P-1	A documented food safety program that incorporates GAP and/or GHP has been implemented.					D
P-2	The operation has designated someone to implement and oversee an established food safety program. Name _____					D

Traceability

	Questions	Points	Yes	NO	N/A	Doc
G-1	A documented traceability program has been established.	15				D
G-2	The operation has performed a "mock recall" that was proven to be effective.	10				R

Worker Health & Hygiene

	Questions	Points	Yes	NO	N/A	Doc
G-3	Potable water is available to all workers.	10				R
G-4	All employees and all visitors to the location are required to follow proper sanitation and hygiene practices.	10				P
G-5	Training on proper sanitation and hygiene practices is provided to all staff.	15				D
G-6	Employees and visitors are following good hygiene/sanitation practices.	15				

Total Points earned for General Questions =

Total Possible	=	180	*The total number of points possible for this section.*
Subtract "N/A"	=		*Enter the additive number of N/A points (+points) here.*
Adjusted Total	=		*Subtract the N/A points from the Total possible points*
X .8 (80%)			*Multiply the Adjusted Total by .8 and show it as the Passing Score*
Passing Score	=		

☐ **Pass** ☐ **Fail** **(please mark one)**

This program is intended to assess a participant's efforts to minimize the risk of contamination of fresh fruits, vegetables, nuts and miscellaneous commodities by microbial pathogens based on the U.S. Fo and Drug Administration's "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables," and generally recognized good agricultural practices.

How to get the most for your $

- Have documents prepared
  - Do a mock audit internally
- Reframe from side conversations with Auditor
  - Have these before audit begins
- Schedule Audits as far in advance as possible
- Share travel time of auditor to your region
  - Association or market broker can assist
- Apply for the cost-share $
- Look to reduce number of different auditor demands from markets

Resources

- Websites
- Videos
- Curriculums
- People!

Hand-washing Units Summary

NCSU Commercial Unit

*Cost: $2,000

Application: Commercial-scale fields

Capacity: 125 gallons

System: Gravity-fed with knee valves

*Minus the trailer

NCSU Farmers Market Unit

*Cost: $2,000

Application: Farmers markets, Events, etc.

Capacity: 125 gallons

System: Pump

*Minus the wagon

"Use-Yer-Foot" Unit

*Cost: $139 (rentals available, $15/day)

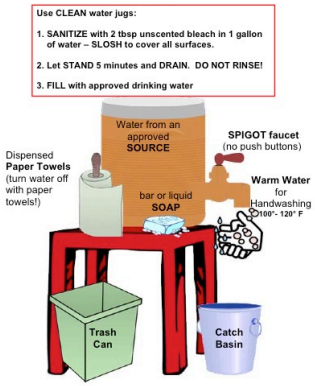
Application: Farmers markets, Events, etc.

Capacity: 10 gallons

System: Gravity-fed with foot pedals

*N.C. residents add state sales tax, shipping not included

Quick & Easy Unit #1



Cost: <$100

Application: Farmers markets, Smaller fields, Events, etc.

Capacity: 5-10 gallons

System: Gravity-fed with valve faucet (no push buttons)

Quick & Easy Unit #2

Cost: <$100

Application: Farmers markets, Smaller fields, Events, etc.

Capacity: 5 gallons

System: Gravity-fed with valve faucet (no push buttons)

N.C. State Hand-washing Stations

- **Rod Gurganus**, director of N.C. MarketReady, the N.C. Cooperative Extension outreach of N.C. State's Plants for Human Health Institute, and **Dr. Gary Roberson**, extension specialist in biological and agricultural engineering, developed two hand-washing station prototypes for producers.
- Took into account producer feedback, construction costs, functionality and used widely available materials like water tanks and plumbing parts to give producers room for customization.
- Construction costs are estimated around $2,000 for both units, minus the support trailer or wagon, but will vary depending on brands, accessories, etc.
- Custom additions can include waste receptacles, steps/ ramps, towel racks and soap dispensers.

(L-R) Dr. Gary Roberson and Rod Gurganus, N.C. State University, developed two hand-washing station prototypes for producers.

Scan Me!

Construction guidelines and photos are available at:
http://ncsu.edu/enterprises/ncfreshproducesafety/hand-washing-unit/

The N.C. Rural Economic Development Center's Agricultural Advancement Consortium funded this project with a $24,000 grant.

N.C. State Commercial Unit

Background

- This facility has a 125gal capacity and is intended for commercial use in fields.
- Gravity-fed system: top tank holds clean water (125gal), bottom tank collects waste water and should have double the capacity of the top tank (250gal).
- Designed for six people to wash their hands (can be customized). Operated by knee valves that control water flow when pressed with the leg (reduces contamination risks from faucets).
- Frame must be able to support the water supply tank when full (1,000lbs). Trailer weight capacity should be 3,000lbs. min.
- Construction costs will vary, but this unit cost about $2,000, minus the trailer.
  - Water tanks: $600/pair
  - Plumbing: $600
  - Support frame: $500
  - Sinks: $300/pair

Scan Me!

Visit http://ncsu.edu/enterprises/ncfreshproducesafety/hand-washing-unit/large-station/ for construction guidelines.

Funding from the N.C. Rural Economic Development Center's Agricultural Advancement Consortium made this project possibl

N.C. State Farmers Market Unit

Background

- Producer feedback highlighted a need for a smaller hand-washing facility for use at farmers markets, one that would be easier to deploy and involve fewer costs.
- This unit holds two 125gal tanks and is operated by a water pump system.
- The sinks fold up and latch for easy transport and storage.
- Construction costs will vary, but this unit cost around $2,000, minus the wagon.
  - Water tanks: $600/pair
  - Pump system (pump, accumulator tank, electrical): $500
  - Plumbing: $400
  - Sinks: $300/pair
  - Accessories (soap dispenser, etc.): $100
- A solar panel could be added to the electrical box for more efficient charging.

Visit http://ncsu.edu/enterprises/ncfreshproducesafety/hand-washing-unit/small-station/ for construction guidelines.

Funding from the N.C. Rural Economic Development Center's Agricultural Advancement Consortium made this project possible.

Scan Me!

On-Farm **Food Safety** Project

Need Help Creating a Food Safety Plan?

The On-Farm Food Safety Project is a comprehensive national program that offers fruit and vegetable farmers, food safety professionals and agricultural extension specialists technical assistance to utilize and teach best practices in food safety.

This website includes the bulk of these resources including a free online tool, based on a comprehensive risk based framework, which generates customized on-farm food safety plans based on user input. The tool is designed for use by small to mid-scale fruit and vegetable growers and provides a full set of record keeping tools to document their food safety program and to provide training to their employees

Learn About Food Safety and Start Your Plan:

How to Get Food Safety Certified

Create a Food Safety Manual

create-manual-button

We are grateful that many leaders in food safety contributed to the development of

www.ncfreshproducesafety.org

NC STATE UNIVERSITY | Back To N.C. MarketReady | **Agent Resources** | N.C. Fresh Produce Safety Task Force | Contact | Search... | Search

NC MARKETREADY™
Fresh Produce Safety – Field to Family
A Program of NC Cooperative Extension

Fresh Produce Safety Portal

Home | Featured Resource | GAPs Grower Directory | Legislative Updates | Program Updates | Recalls | Trainings & Events

About | GAPs | Consumers | Growers | Processors | Trainers | Spanish | Glossary & FAQ | Diane's Blog

The N.C. MarketReady team has compiled valuable resources and materials on this Fresh Produce Safety Web portal, including information on traceability, postharvest quality, cost share opportunities, Good Agricultural Practices (GAPs) and more.

For more information about Fresh Produce Safety in North Carolina, contact:

Diane Ducharme
Extension associate & GAPs program coordinator
704-250-5402

Rod Gurganus
Director, N.C. MarketReady
252-793-4428

James Oblinger
Professor, Dept. of Food, Bioprocessing and Nutrition Sciences
704-250-5447

Featured Resource

Food Safety Modernization Act Webinar
The N.C. Fresh Produce Safety Task Force (NCFPSTF) and N.C. Farm Bureau (NCFB) present a webinar regarding the recent Food Safety Modernization Act. The webinar is moderated by Diane Ducharme, with NCFPSTF and N.C. MarketReady, and Debbie Hamrick, with NCFPSTF and NCFB.

Recalls

Search for Growers Trained in Fresh Produce Safety

N.C. Cooperative Extension agents have been conducting Tier 1 trainings throughout the state using the N.C. MarketReady Fresh Produce Safety GAPS Training curriculum.

Search the GAPs Grower Directory >>>

Program Updates

Fresh Produce Safety Trainings Make an Impact in 2010

The N.C. MarketReady Fresh Produce Safety – Field to Family Good Agricultural Practices (GAPs) Training Curriculum is bearing fruit for the nearly 300 growers and more than 120 Extension agents who have completed the training. Read more to find examples of the impacts the training is having on N.C. farms.

See Previous Program Updates >>>

Trainings & Events

N.C. MarketReady Fresh Produce Safety – Field to Family GAPs Training Calendar

N.C. Cooperative Extension agents conduct the N.C. MarketReady Fresh Produce Safety – Field to Family GAPs training curriculum at N.C. Cooperative Extension offices and other locations across the state. The curriculum trains growers on how to minimize food safety risks. Review the list of recent and upcoming trainings in the calendar.

Fresh Produce Safety Symposium 2010

September 9, 2010
This symposium is targeted to growers, industry, academics, policymakers, regulators and Extension agents. The primary focus will be on professional recommendations for Good Agricultural Practices (GAPs) and Good Handling Practices (GHPs) for fresh produce safety and protection of public health. Speakers will relay the details of fresh produce and food safety initiatives and research in their states, providing both regional and national perspectives.

Postharvest Diseases of Small Fruits

Bill Cline, Plant Pathology Department
North Carolina State University
Horticultural Crops Research Station
Castle Hayne, NC

NC STATE UNIVERSITY

Some small fruit crops grown in North Carolina


Muscadine Grape


Rabbiteye Blueberry


caneberries


Highbush Blueberry


Strawberry

NC STATE UNIVERSITY

What Causes Fruit to Rot?

- Mostly fungi. . . .
- Spores are microscopic
- Spread by wind, splashing rain, or insects
- Infection requires:
  - A susceptible host
  - A virulent pathogen
  - Moisture
  - Temperature
  - Time

Machine harvest and packing increases the risk of decay

- Bruising
- Contamination of surfaces
- Increased handling
- Time
- Temperature
- Moisture

Postharvest Rot = Decay of healthy or apparently healthy berry after it has been picked

- Almost always caused by a fungus
- Mold or spores often visible on berries, Some fungi cause leaky berries
- Consumer's "quality check" -- easily seen through clear plastic clamshell cups

Blueberry fruit rots (can occur pre-harvest as well)

- *Alternaria* rot (shown)
- Anthracnose ripe rot *(Colletotrichum)*
- Soft rot and calyx-end rot *(Phomopsis vaccinii)*
- Botrytis gray mold *(Botrytis cinerea)*
- Other fungi (*Rhizopus, Cladosporium*)
- Overripe or damaged fruit

Exobasidium and mummy berry are pre-harvest fungal diseases that do not spread or increase in postharvest environments, but may reduce grade if not sorted out.

Exobasidium spot

Mummy berry

Milholland, R. D. and Jones, R. K. 1972. Postharvest Decay of Highbush Blueberry Fruit in NC. Plant Disease Reporter 56:118-121

- *Alternaria* was found to be the primary blueberry postharvest rot organism in NC
- Fungicides, Hot Water Treatment, Clorox treatment NOT effective in reducing rots
- Postharvest cooling was VERY effective in reducing rots
- Cooling within 2 hr after harvest significantly better than 12 hr after harvest

Mainland, C. M. et.al., 1975. The Effect of Mechanical Harvesting on Yield, Quality of Fruit and Bush Damage on Highbush Blueberry. J.A.S.H.S., 100:129-134

- Machine harvesting reduced yields of marketable fruit by 19% to 44%
- 10% to 30% softer than hand harvested fruit
- Machine harvested fruit developed 11% to 41% more decay after 7 d storage at 70^{o}F
- Sorting increased rots of mechanically harvested fruit by an additional 5% to 10%

Cappellini, R. A. et.al., 1982. Nature and Extent of Losses in Consumer-grade Samples of Blueberries in Greater New York. HortScience 17:55-56

- Consumer samples averaged 15.2% defective fruit during a two-yr study
- Fungal decay accounted for two-thirds of defective fruit

Ballinger, W. E. et.al., 1978. Postharvest Decay of Blueberries as Influenced by Stem Attachment and Ripeness. Plant Disease Reporter 62:316-319

- Just-ripe, Stemless berries had 9 to 11 times as many rots as just-ripe berries with stems still attached
- Over-ripe, Stemless berries had 2.3 to 3.2 times as many rots as over-ripe berries with stems still attached

Ballinger, W. E. et.al., 1978. Relationship of Stage of Ripeness and Holding Temperature to Decay Development in Blueberries

- Berries held at 34, 50 or 70°F. Only fruit held at 34°F had good enough storage life to justify sorting by degree of ripeness

Norman, D. J. and Strandberg, J. O. 1997. Survival of *Colletotrichum acutatum* in Soil and Plant Debris of Leatherleaf Fern. Plant Disease 81:1177-1180

- Survival of spores for up to 3 months in dry soil or in dried plant debris
- Spores applied to denim fabric could be recovered up to 5 wk later, detected as colony-forming units (CFUs) in culture

Ramsdell, D. C. 1994. Evaluation of Foliar Fungicides for Control of Post-Harvest Fruit Rots. Fungicide & Nematicide Tests 49:57-58

- Postharvest *Alternaria* rot of blueberry was not controlled by fungicides when berries were commercially handled; some fungicides made it worse
- Postharvest Anthracnose ripe rot of blueberry (*Colletotrichum* sp.) was reduced by all fungicides tested when berries were commercially handled

Mainland, C. M., 1995. Blueberry Handling, Packaging and Storage Studies. Proceedings of the North Carolina Blueberry Council 29th Annual Open House, p.7-10

- Drops of 0, 2, 4, 6 ft resulted in marketable percentages of 86, 67, 43, 31, respectively after 7 days at 70^{o}F
- Studies in Australia & US -- No detrimental effect if berries held for up to 8 hrs at 64^{o}F before cooling to ideal temperature

Cline, W. O. 1996. Postharvest Infection of Highbush Blueberries Following Contact with Infested Surfaces. HortScience 31:981-983

- Harvested every 7 days, only visibly healthy berries were used in the treatments
- Infested metal pan with either *Alternaria* or *Colletotrichum* by rolling sporulating fruit on the surface (5 s)
- Healthy berries rolled on infested pan (5 s)
- Rated after 7 days at 70^{o}F

Percent rots occurring on the cultivar Bluechip (small dry stem scar) after 7 d at 70°F

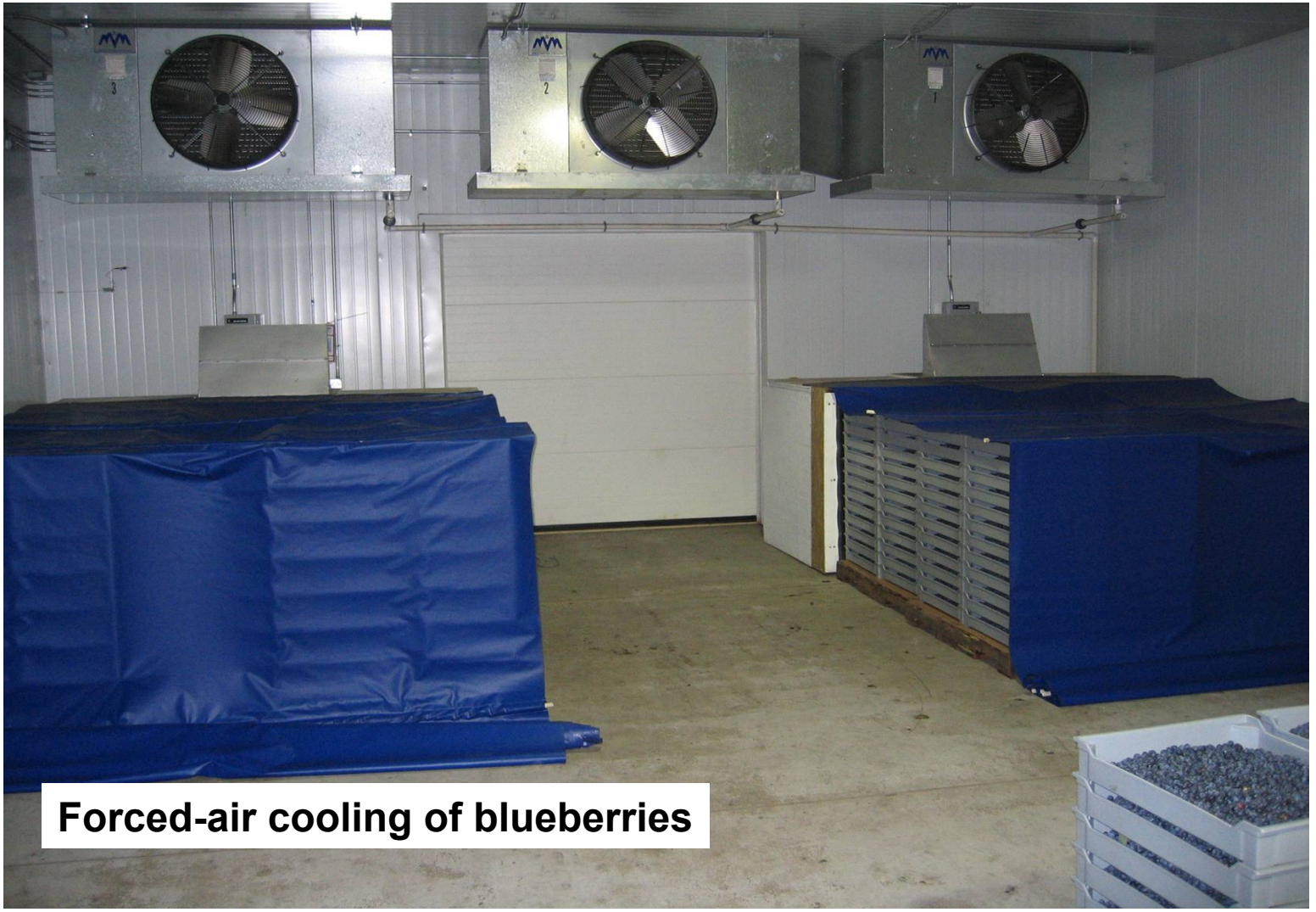
	No spores on surface		Inoculated surface	
	Ripe Rot	Alternaria	Ripe Rot	Alternaria
No Sorting	1.5	10	--	--
Sort Dry	2.1	9.1	3.6	10.3
Sort Wet	8.2	29.8	63.5	25.0

Summary of Blueberry Handling Experiments

- Commercial handling infests berries with spores and increases the chance of decay
- Handle berries dry -- moisture is required for postharvest sporulation & infection
- Large/wet stem scars provide sufficient moisture for infection and thus increase rots
- Spores are always present in nature -- you must always cool to prevent mold

Fresh-pack blueberry practices to reduce postharvest decay

- Select cultivars for resistance, dry stem scar
- Use fungicides
- Timely, thorough harvest (every 4-7 days for highbush, 7-10 day for rabbiteye)
- Machine for processing if too much overripe fruit
- Handle berries dry
- Provide a clean pick/pack environment
- Cool (dry) pre-pack followed by forced air

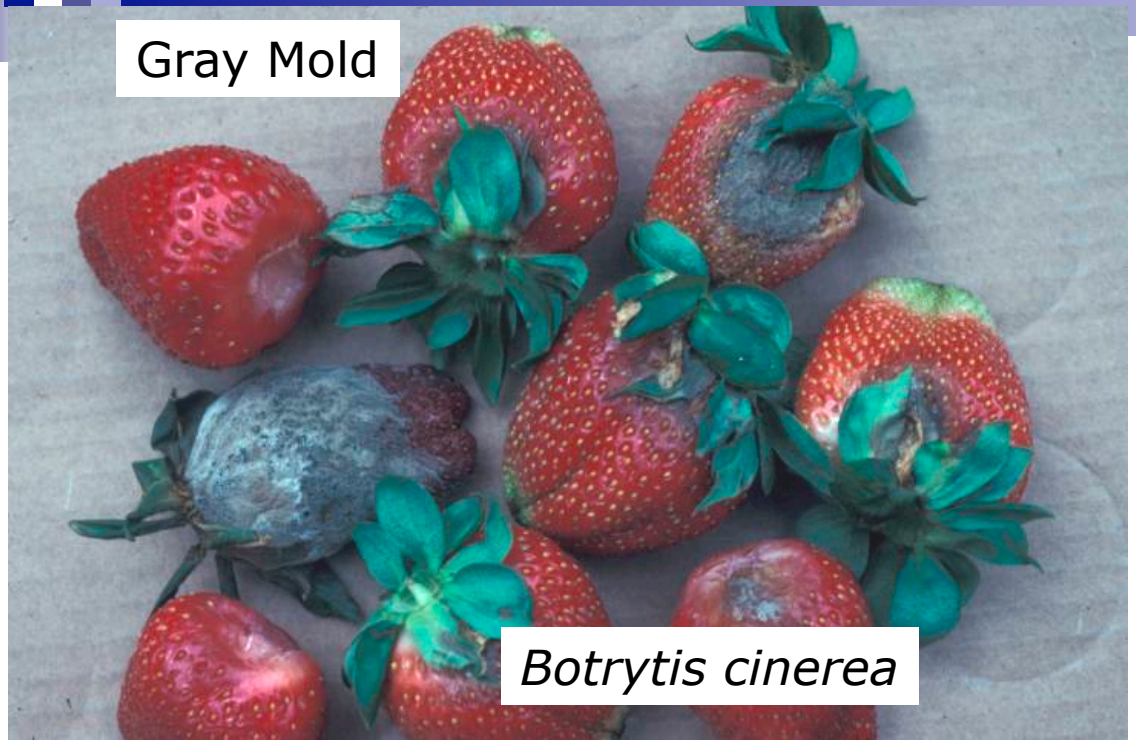


Forced-air cooling of blueberries

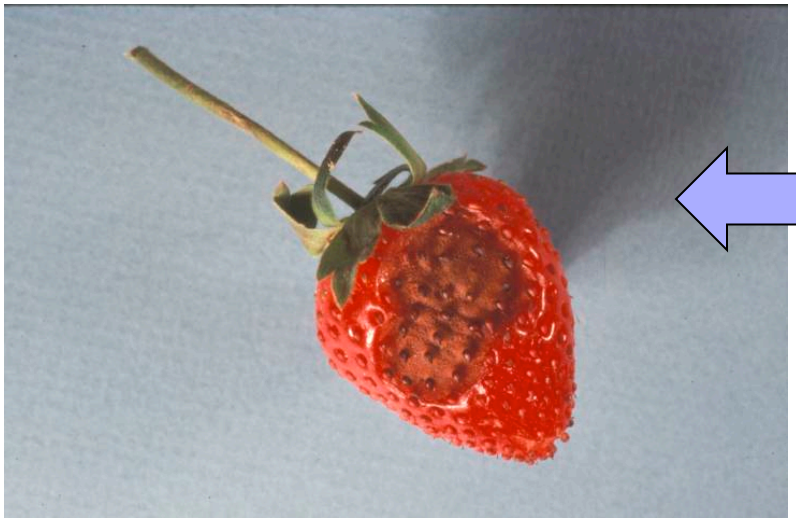
Strawberry Postharvest Diseases

- Anthracnose of crowns, runners, petioles and fruit – *Colletotrichum* spp., usually *C. acutatum*
- Gray Mold – *Botrytis cinerea*
- Angular leaf spot – *Xanthomonas fragariae* – causes “brown cap” symptom
- Overripe, sunscald, rain damage
- Other fungi

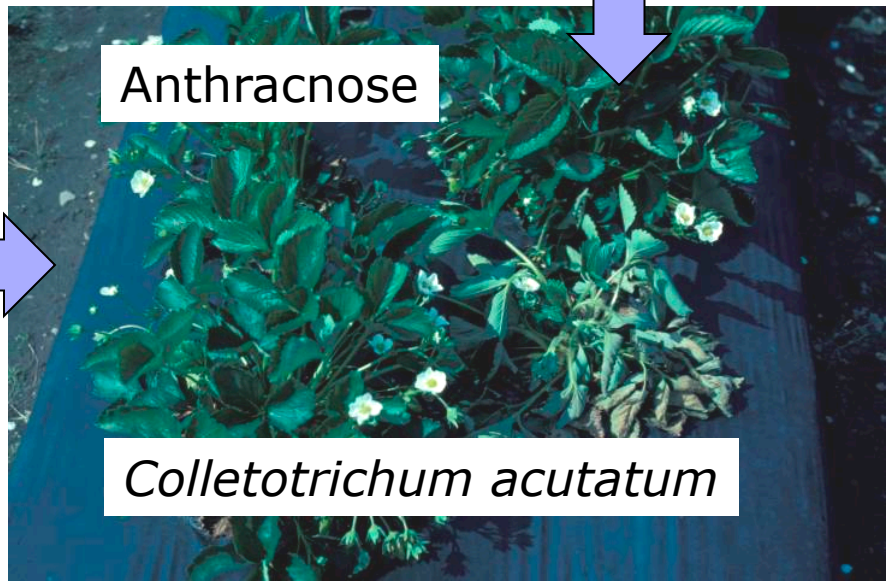
Gray Mold



Botrytis cinerea



Anthracnose



Colletotrichum acutatum

Fresh-pack strawberry practices to reduce postharvest decay

- Select cultivars for resistance
- Remove old leaves and infected flower clusters prior to first harvest
- Use fungicides for anthracnose, botrytis
- Timely, thorough harvest every 3-4 days or less
- Do not “cap” berries
- Handle berries dry
- Cool by forced air

Muscadine Grape Postharvest Diseases

- Fruit rots –
  - Ripe rot *(Colletotrichum sp.)*
  - Macrophoma rot *(Botryosphaeria sp.)*
  - Bitter rot *(Greeneria uvicola)*
- Overripe
- Secondary decay, souring/fermentation

Muscadine

Macrophoma rot
Botryosphaeria spp.

Bitter Rot
Greeneria uvicola

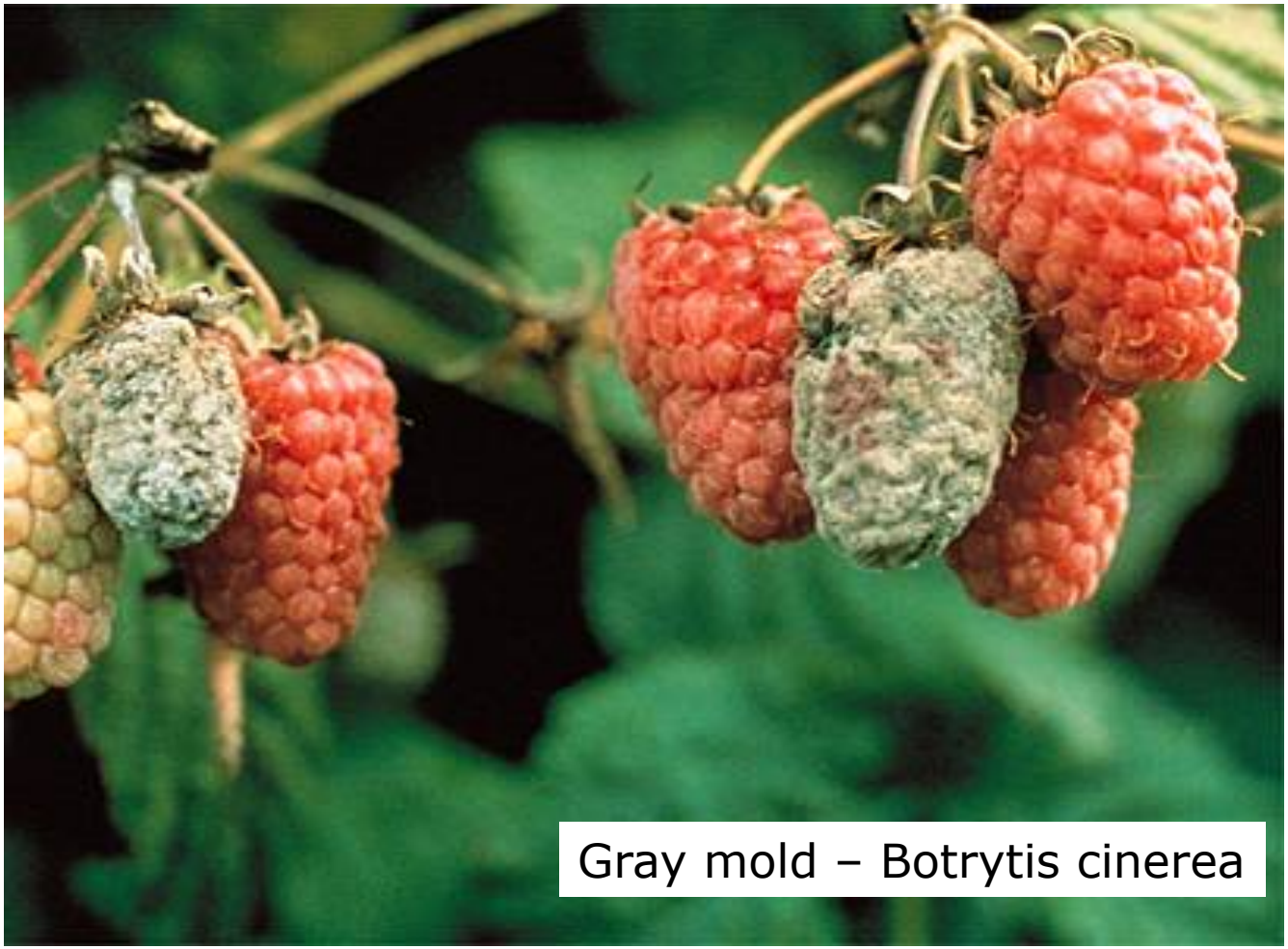
Ripe rot
Colletotrichum spp.

Fresh-pack muscadine practices to reduce postharvest decay

- Select cultivars for resistance, dry stem scar (Dark-fruited cultivars have far less decay)
- Use fungicides
- Timely, thorough harvest (weekly)
- Handle berries dry
- Provide a clean pick/pack environment
- Cool (dry) pre-pack followed by forced air

Caneberry Postharvest Diseases

- Gray mold – *Botrytis cinerea*
- Leaky berries – (overripe fruit, sunscald, rain damage)
- Other fungi (*Colletotrichum, Rhizopus, Cladosporium*)


Gray mold – Botrytis cinerea

Fresh-pack caneberry practices to reduce postharvest decay

- Select cultivars for resistance
- Use fungicides
- Timely, thorough harvest (every 1-3 days)
- Handle berries dry, minimize handling (pick into consumer-ready containers)
- Cool as soon as possible with forced air

HAND-WASHING UNITS SUMMARY

Scan Me!

NCSU Commercial Unit

*Cost: $2,000

Application: Commercial-scale fields

Capacity: 125 gallons

System: Gravity-fed with knee valves

*Minus the trailer

NCSU Farmers Market Unit

*Cost: $2,000

Application: Farmers markets, Events, etc.

Capacity: 125 gallons

System: Pump

*Minus the wagon

"Use-Yer-Foot" Unit

*Cost: $139 (rentals available, $15/day)

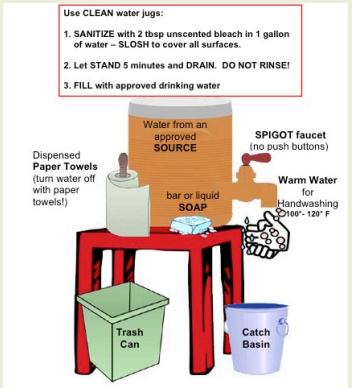
Application: Farmers markets, Events, etc.

Capacity: 10 gallons

System: Gravity-fed with foot pedals

*N.C. residents add state sales tax, shipping not included

Quick & Easy Unit #1



Cost: <$100

Application: Farmers markets, Smaller fields, Events, etc.

Capacity: 5-10 gallons

System: Gravity-fed with valve faucet (no push buttons)

Quick & Easy Unit #2

Cost: <$100

Application: Farmers markets, Smaller fields, Events, etc.

Capacity: 5 gallons

System: Gravity-fed with valve faucet (no push buttons)

NC State University A&T State University COOPERATIVE EXTENSION Empowering People · Providing Solutions

Visit http://ncsu.edu/enterprises/ncfreshproducesafety/hand-washing-unit for more details.

The N.C. Rural Economic Development Center's Agricultural Advancement Consortium funded N.C. State's units.

NC STATE UNIVERSITY Plants for Human Health INSTITUTE

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Spotted Wing Drosophila

A new invasive pest of Michigan fruit crops

Rufus Isaacs and Noel Hahn, Department of Entomology
Bob Tritten and Carlos Garcia, MSU Extension

MSU Extension Bulletin E-3140
New • October 2010

Introduction

The Spotted Wing Drosophila (SWD) is a small vinegar fly with the potential to damage many fruit crops. It was first detected in Michigan in late September 2010. Unlike most other vinegar flies that require damaged fruit to attack, SWD causes damage when the female flies cut a slit and lay eggs in healthy fruit. This insect is a pest of most berry crops, cherries, grapes and other tree fruits, with a preference for softer-fleshed fruit. Given the propensity for this insect to spread and its potential to infest fruit, it is important to learn about monitoring and management of SWD to minimize the risk of larvae developing in fruit and affecting fruit marketability.

SWD, or *Drosophila suzukii*, was first discovered in the western United States in 2008 and moved quickly through the Pacific Northwest into Canada. In the spring of 2010, SWD was discovered in Florida on strawberries and detected later in the summer in the Carolinas. It has also been detected in Europe. Because the flies are only a few millimeters long and cannot fly very far, human-assisted transportation rather than natural dispersion is the most likely cause of the recent rapid spread.

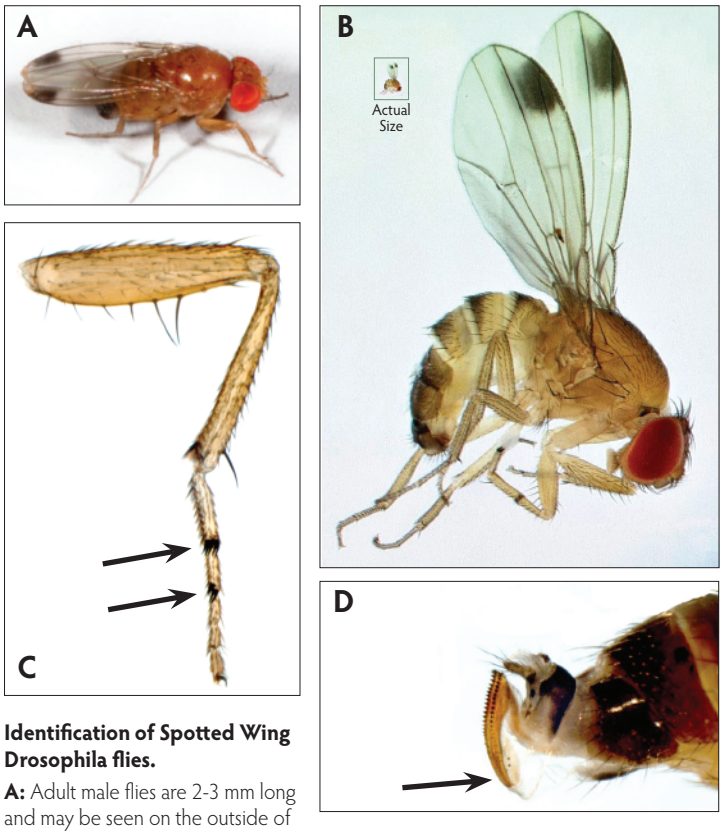
Damage

Female SWD can cut into intact fruit using their serrated ovipositor to inject eggs under the skin. By being able to insert eggs into intact fruit, the larvae of SWD can be present during ripening, leading to a risk of detection in ripe fruit after harvest. During egg-laying, sour rot and fungal diseases can also be introduced, further affecting fruit quality. There is a greater risk of fruit contamination at harvest from SWD compared with native species that lay eggs only in already-damaged and rotting fruit.

The adult SWD lives for about two weeks, and can lay more than 100 eggs in a day. This demonstrates their high potential for fruit infestation and spreading through a field if not controlled. Infested fruit do not show obvious symptoms of infestation at first, with only a small pin-prick visible from egg-laying. Within a few days, the fruit flesh will start to break down, leading to discolored regions and eventual collapse of the tissues. By this point, the white larvae can be relatively easy to detect.

SWD Management

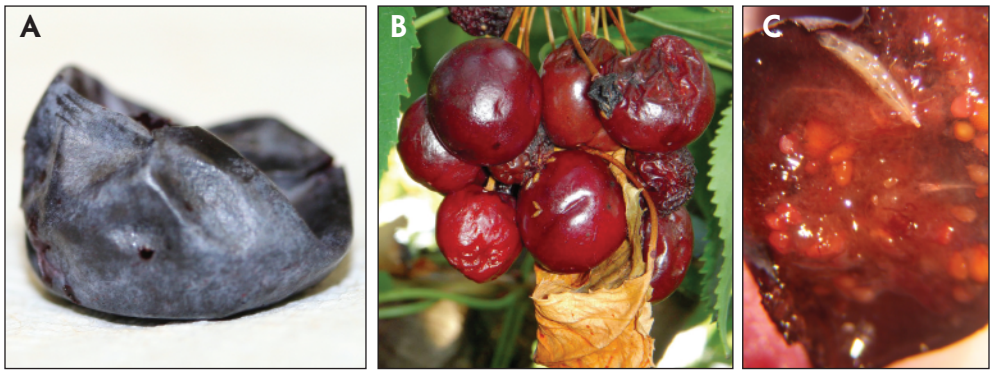
There are three important components to effective SWD management: Monitoring, Identification, and Control.



Identification of Spotted Wing Drosophila flies.

A: Adult male flies are 2-3 mm long and may be seen on the outside of fruit. **B:** The male SWD has two distinctive dots on the wings (females do not have the wing spots). **C:** Male flies also have two dark bands on the forelegs. **D:** On the female SWD, the serrated ovipositor is a distinctive morphological feature, longer than other vinegar fly species and with two rows of serration. Photos by Martin Hauser (A, C, D) and Gorak Arakelian (B).

Monitoring: The first and most important step is to determine whether SWD are present. This can be done using a simple monitoring trap, consisting of a plastic 32 oz. cup with several 3/16" -3/8" holes around the sides of the cup, leaving a 3" to 4" section without holes to facilitate pouring out liquid. The holes can be drilled in sturdy containers or burned with a hot wire or wood burner in the thinner plastic cups. Pour 1" to 2" of pure apple cider vinegar into the trap as bait. To help attract flies and ensure that trapped flies do not escape, a small yellow sticky trap is placed inside the trap. Traps are hung in the shade in the fruit zone using a stake or a wire attached to the sides of the trap, and fastened to a branch or trellis



Fruit infestation symptoms: A: Collapsed blueberry one week after infestation. **B:** Diseased cherry tissue associated with SWD infestation. **C:** SWD larvae are white and visible against the darker fruit. Photos by Vaughn Walton (A), Peter Shearer (B) and Tracy Hueppelsheuser (C).

wire. Check traps at least weekly for SWD flies, and change the vinegar. Pour the old vinegar into a bottle or away from the trap location, and place traps back near the crop with fresh vinegar. Continue monitoring through harvest and post-harvest.

Identification: Some native species of vinegar flies and other insects will be attracted to the traps. These need to be distinguished from SWD flies. Vinegar flies are small (2 - 3 mm) with rounded abdomens. Examine the wings of trapped vinegar flies using a hand lens. Some small native flies have dark patches on the wings, but will not have the distinctive dark dot that is present on both wings of SWD males. Female SWD are harder to identify, but this can be done by using a hand lens to examine the ovipositor (see photo on previous page). Keep a clear record of the number of SWD detected at each check. Given the importance of early detection, it is imperative that possible detections in new areas are clearly identified by sending them to the address below. If SWD are found in traps, start management activities immediately.

Monitoring trap for SWD. A plastic container with holes, containing apple cider vinegar as a bait, and a sticky trap to catch flies. Photo: Rufus Isaacs.

Control: There are some important cultural controls that growers can adopt to minimize the buildup of populations. These include removing overripe fruit, wild host plants such as wild grape, raspberry, blackberry, etc. from nearby fields, and ensuring timely crop harvest. If SWD are detected in fruit farms, active management programs should be implemented immediately, including the cultural controls described above, coupled with monitoring and control of adult flies using insecticides with knock-down activity (see below). Additional monitoring should be done to determine the approximate distribution of SWD across various fields.

Michigan fruit growers already use IPM programs to manage fruit flies (blueberry maggot, cherry fruit fly, and apple maggot) during the summer months, and these programs will provide some protection against SWD. However, these fruit flies have only one generation a year, and a week between emergence and egg-laying. SWD lays eggs soon after emergence and will complete multiple generations under Michigan conditions. For these reasons, spray intervals should be tightened if SWD is detected to prevent infestation before harvest.

A number of registered insecticides have shown high activity on SWD in recent trials conducted in western states. These include organophosphate and synthetic pyrethroid insecticides, with lower activity and residual control from spinosyn and organic pyrethrum class insecticides. Many of these trials have been in laboratory trials or field trials with different conditions than the humid Midwest. Selection of insecticides for SWD control should take into account the other pests present, harvest date, re-entry restrictions, as well as potential impacts on existing IPM programs, beneficial insects, and the environment. Refer to MSU Fruit CAT Alerts and Extension publication E-154 for the latest insecticide recommendations, and follow IPM newsletters for timely updates during the season. Remember to follow the label restrictions and rotate chemical classes to avoid resistance development. If this pest is present, the level of control will depend on the size of the SWD population, timeliness of application, coverage of fruit, and product effectiveness.

Follow Future Developments

There is active research and monitoring underway to minimize the impact of SWD on fruit production. As new information is available, it will be posted online at www.ipm.msu.edu/SWD.htm and will be distributed to fruit growers via MSU Extension programs.

Flies suspected of being SWD can be placed in a plastic zippered bag or small vial and sent for identification to:

Howard Russell, SWD Monitoring Program
Diagnostic Services
101 CIPS, MSU, East Lansing, MI 48824.

Include location/date collected and your contact information.

This fact sheet was produced with support from Project GREEEN and the Michigan Agricultural Experiment Station. For more information, check the Michigan State University SWD Page online at **www.ipm.msu.edu/SWD.htm** or at the Oregon State University SWD website at **swd.hort.oregonstate.edu**

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N.C. Websites/Resources

N.C. Fresh Produce Safety – www.ncfreshproducesafety.org
This website focuses on fresh produce safety as one of the core educational areas for N.C. Cooperative Extension personnel and N.C. growers. The team has compiled valuable resources and materials on its fresh produce safety website, including information on traceability, postharvest quality, cost share opportunities, Good Agricultural Practices (GAPs) and more.

Agent Resources – http://www.ncsu.edu/fvsi/value-added/agents/index.php?section=agent-resources-home
An NCSU Unity sign-in is required to access this site. All PPT, webinars, GAPs Grower participatory certificates, etc. are housed on this site.

Tier 1, Version 2 Curriculum – http://tiny.cc/hix3dw
Version 2 of Tier 1 provides shortened PowerPoint presentations (~30 slides per module) and also introduces a handout with activity suggestions and introductions of GAPs implementation tools for each module.

Tier 2 Curriculum – http://tiny.cc/1ix3dw
These materials (Tiers 1 & 2) are for agent reference only. Temporarily housed at this website till new webpage launch (July 2012).

Good Farmers Market Practices – http://ncgoodfarmersmarketpractices.wordpress.com
This website serves to disseminate information based on the Good Farmer's Market Practices (GFMPs) curriculum. GFMPs is a new food safety curriculum developed by N.C. Cooperative Extension, including the following modules: Food Safety Principles, Personnel Health & Hygiene and Food Sampling. The curriculum is intended to provide information to enhance the safety of products sold and practices at farmer's markets across North Carolina.

Produce Crisis Management – https://producecrisismanagement.wordpress.com/
Crisis preparedness and management training for the Produce Industry. This website includes training materials and several table-top training scenarios using select produce and pathogen scenarios as indicators of possible food outbreaks in the industry (E. coli and greens, Hep A and strawberries, and Salmonella and tomatoes).

Food Safety Info Sheets – http://foodsafetyinfosheets.wordpress.com/
The Food Safety Info Sheets website is designed and maintained by Dr. Benjamin Chapman and his team at North Carolina State University. Food safety infosheets are passive, postable communication tools targeted at the food service industry (food handlers and business operators). The infosheets are used to provide food safety risk-reduction information to generate behavior change.

Opening Markets – http://gapsmallfarmsnc.wordpress.com/
Exploring and Communicating Food Safety Barriers. This website represents an open-source project that is gathering information on costs and barriers from 12 small farms (less than 20 acres, at least 8 commodities) across North Carolina as they go through steps that could lead to USDA GAP certification. These steps include addressing risks and collecting documentation on food safety practices, which are often cited as the biggest issues. Many of our participating farms have chosen to open up what they are doing in hopes of creating and communicating approaches to food safety that are practical for small farms. Through this project we will

identify practice, facilities and system barriers to the current GAP certification process as well as the economic barriers that have been alluded to in previous reports.

Food Safety Culture Team – http://chapmanfoodsafety.wordpress.com/
The food safety culture team in the Department of 4-H Youth Development and Family & Consumer Sciences at North Carolina State University places emphasis on engaging individuals in dialogue about food-related risks, controls and benefits, from farm-to-fork. The program strives to design, implement and evaluate novel food safety risk analysis-based interventions and provide reliable, relevant information in culturally and linguistically appropriate formats to assist people in identifying, understanding and mitigating the causes of foodborne illness.

BarfBlog – www.barfblog.com
Barfblog.com is a complimentary and comprehensive resource for those interested in microbial food safety – the things that make people barf. Barfblog.com is where Drs. Powell, Chapman, Hubbell and assorted food safety friends offer evidence-based opinions on current food safety issues. Opinions must be evidence-based – with references – reliable and relevant.

Diane's Blog – http://ncfreshproducesafety.wordpress.com/
This blog may have answers to a lot of the questions – use the "SEARCH" option to explore the topics.

GAPs Worker Training Requested by Growers –
http://ncfreshproducesafety.wordpress.com/2011/05/10/gaps-worker-training-requested-by-growers/
Non-English speaking employees represent the majority of North Carolina's farm labor force. Growers have requested a versatile and easily adaptable training tool that can be used during their informal morning meetings to continually educate their workforce with language appropriate materials and visuals pertinent to agricultural work conditions. A series of eight videos available in English and Spanish have been created covering the topics of:

Video 1 - Worker Health and Hygiene Training
English Version. http://www.youtube.com/watch?v=tI-3OpymNHU
Español Version. http://www.youtube.com/watch?v=bDUy4uHYZnU
Video 2 - Hand Washing Training
English Version. http://www.youtube.com/watch?v=enE36uZ9Rfc
Español Version. http://www.youtube.com/watch?v=IG0zAb9Wx_o&feature=related
Video 3 - Sanitary and Hand Washing Facilities Training
English Version. http://www.youtube.com/watch?v=7WsprbHKV7U
Español Version. http://www.youtube.com/watch?v=eN9Ax-2_COs&feature=related
Video 4 - Cross Contamination Training
English Version. http://www.youtube.com/watch?v=2PYrvHioIHw
Español Version. http://www.youtube.com/watch?v=AL59fCl6Ozw&feature=related
Video 5 - Cleaning and Sanitation Practices Training
English Version. http://www.youtube.com/watch?v=jYIG7iIX0EM&feature=related
Español Version. http://www.youtube.com/watch?v=__QQJ-etIqk&feature=related
Video 6 - Wash Water Monitoring Training
English Version. http://www.youtube.com/watch?v=MfGcYKfzmkE
Español Version. http://www.youtube.com/watch?v=rLuWULjjak8&feature=related
Video 7 - Proper Food Safety Practices in the Home Training
English Version. http://www.youtube.com/watch?v=5-fhnejRjOU
Español Version. http://www.youtube.com/watch?v=saK99Y-zo-E&feature=related
Video 8 - Infield Practices Training
English Version. http://www.youtube.com/watch?v=cUf65Qyoxbw&feature=related
Español Version. http://www.youtube.com/watch?v=3nrmtuG346E&feature=related

NCSU – Food, Bioprocessing and Nutrition Sciences. Extension "Entrepreneur Initiative for Food (ei4f)"
http://www.ncsu.edu/foodscience/extension_program/entrpreneurs.html
Help is available for you from the Entrepreneur Initiative for Food, whether you only have an idea, are just starting up or have already established a food-based business. From small, cottage-type industries to large processing plants, there is a variety of assistance available. Topics covered include starting a food business, product testing and nutritional labeling to name a few.

NCDA – Food & Drug Protection Division. "Starting a Food Business"
http://www.ncagr.gov/fooddrug/food/foodbiz.htm
This site answers many questions from a regulatory standpoint on what a person needs to do to start a food business in North Carolina.

NCDA – Food & Drug Protection Division. "Starting a Home-based Food Business"
http://www.ncagr.gov/fooddrug/food/homebiz.htm
This site provides a step-based guide on what products can be produced at home, application processes and all the other necessary steps in one concise website.